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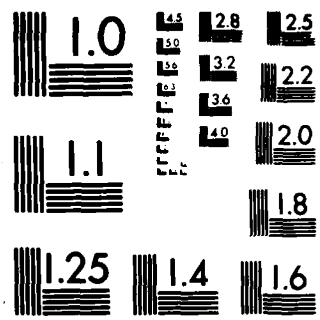

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A SYSTEMS ANALYSIS OF

OUTBOUND SURFACE FREIGHT

THESIS

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AFIT/GLM/LSM/84S-29

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AFIT/GLM/LSM/84

THE ON-LINE CARGO MOVEMENT SYSTEM: A SYSTEMS ANALYSIS OF OUTBOUND SURFACE FREIGHT

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THE ON-LINE CARGO MOVEMENT SYSTEM: A SYSTEMS ANALYSIS OF OUTBOUND SURFACE FREIGHT

THESIS

Presented to the Faculty of the School of Systems and Logistics
of the Air Force Institute of Technology
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Master of Science in Logistics Management

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Table of Contents

Page

List of Figures

List of Tables

Abstract

This research assisted the Air Force Data Systems Design Center in the development of an automated management information system for cargo movement by identifying the information needs of the On-Line Cargo Movement System when processing cargo in outbound surface freight. To accomplish this research, the following four subobjectives were identified:

1) Define the current outbound surface freight system.
2) Identify the required decisions/tasks of the system.
3) Determine the information needs for the required decisions/tasks.
4) Outline the general system objectives needed to support known information requirements.

To achieve these research subobjectives, several systems analysis techniques and tools were employed in a three-step methodology. In the first step, determining the theoretical operation of an outbound surface freight system, interviews and documentation review were used. The second step, defining the existing outbound surface freight system, involved observation, documentation review, flowcharting and interviews. Recommending a new or improved system, the final step, made use of interviews and structured systems analysis.

Analysis of the existing outbound surface freight system revealed 12 major problems in the four general areas of documentation, customer service, reports generation and inventory

control. Further analysis resulted in the following recommendations:

- Consolidate workload and shipment data into one file called Shipment History.
- Consideration should be given to acquiring automated word processing equipment.
- Centralize the recording, compiling and submission of workload data.
- Replace the present manual filing procedures with an automated filing system.
- Incorporate electronic document transmission capability in the proposed automated system.
- Consolidate codes, statements and instructions required in the preparation of documents into a set of user/task-oriented files.
- Establish an automated packaging material inventory control system.

The major conclusion of this research was that an automated system incorporating the recommended capabilities could be developed. Therefore, current efforts to develop the On-Line Cargo Movement System should continue.

THE ON-LINE CARGO MOVEMENT SYSTEM:

A SYSTEMS ANALYSIS OF

OUTBOUND SURFACE FREIGHT

I. Introduction

General Issue

At the Worldwide Transportation Conference in October 1983, Brigadier General John E. Griffith, Air Force Director of Transportation, stated that the automation of base-level transportation systems should be the foremost concern among transporters during 1984 (1). While automation efforts aimed at more efficient management and processing of information are ongoing in base-level airlift, vehicle and personal property functions, cargo movement remains a predominantly manual operation. To satisfy this need for automated cargo movement capability, the Air Force Data Systems Design Center (AFDSDC) recently received approval to begin work on the On-Line Cargo Movement System (OLCMS). This research assisted the AFDSDC in the development of OLCMS.

Background

Before addressing the specific problems with the current cargo movement system, the reader should be familiar with the organization of base-level transportation and the management information systems in use in each area. A management information system (MIS), as it relates to our transportation systems research, can be defined in terms of its individual components: management, information and the system. Management involves the coordination of human and material resources toward the accomplishment of some objective. Information, the foundation upon which management decisions are based, is data that have been processed into a form meaningful to the recipient and of real or perceived value in current or prospective decisions. A system is a set of interrelated elements working together toward some common purpose (2:17;3). In other words, a MIS is simply a system to provide information to managers. Ives, Hamilton and Davis (4:910) point out a distinction MIS researchers have made between management-oriented and transaction processing-oriented information systems. While a management-oriented MIS provides information for making organizational policy decisions, a transaction processing-oriented system is characterized by simple and repetitive information used to insure operational tasks are carried out effectively and efficiently (5:45,53-54). In transportation, both types of MIS's are found in the three major functional areas: airlift, vehicles and traffic management. Figure 1 summarizes current standard transportation information systems and outlines future systems with projected implementation dates.

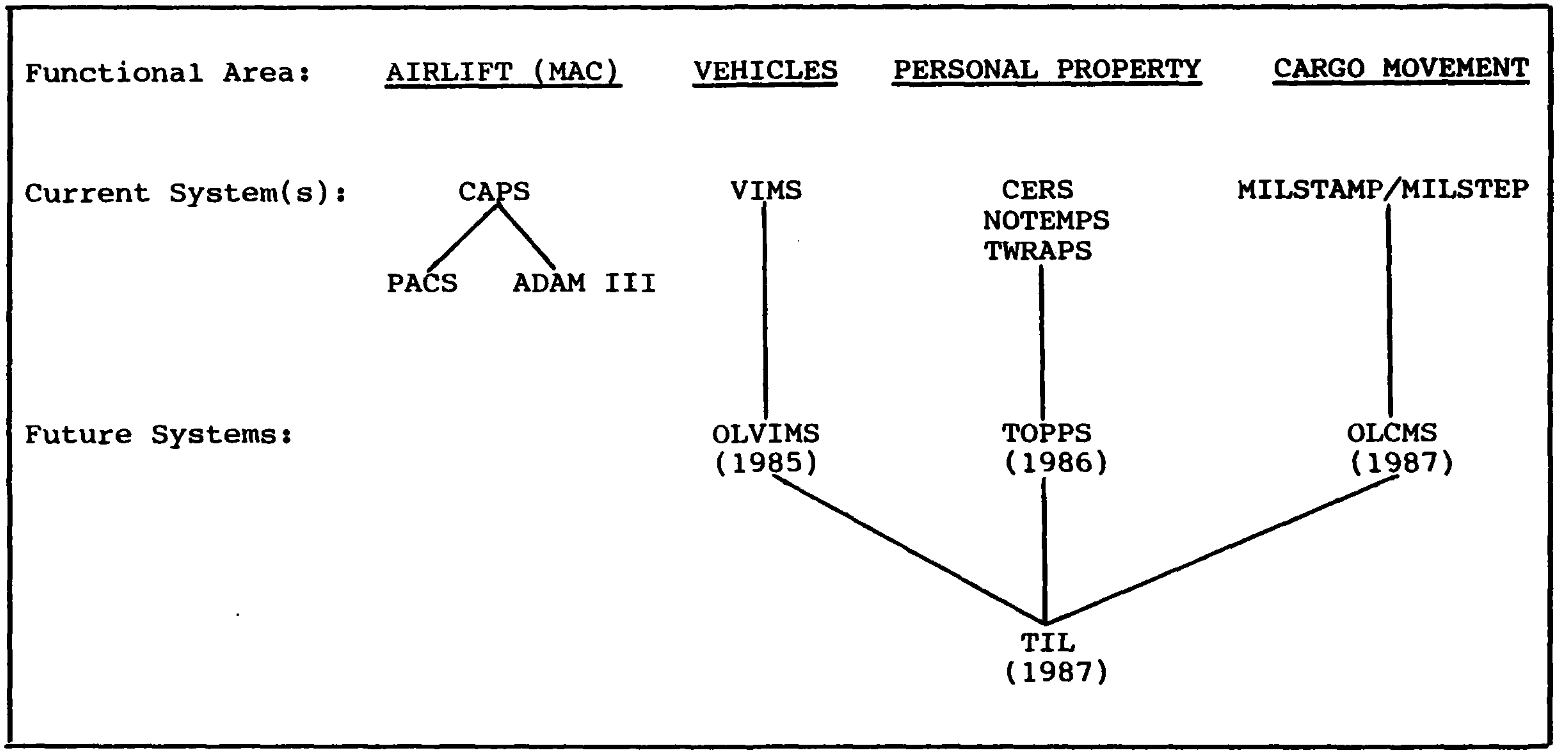

Fig 1. Current and Planned Transportation Information Systems Source: (6)

The first functional area of transportation, airlift, involves movement of passengers and cargo via Military Airlift Command (MAC) assets. MAC is currently upgrading both passenger and cargo processing capabilities through the worldwide implementation of the Consolidated Aerial Port Subsystem (CAPS). On the passenger side of the airlift area, the Passenger Automated Check-In System (PACS) is currently being installed, automating MAC's passenger check-in and ticketing operations. MAC cargo documentation procedures are simultaneously being automated with the installation of the Aerial Port Documentation and Manifesting System III (ADAM III) (7).

Vehicles, the next major functional transportation responsibility, includes Vehicle Management and Vehicle Maintenance. While Vehicle Management is responsible for base vehicle support, Vehicle Maintenance is tasked with the upkeep of the base vehicle fleet. The automated MIS presently serving both vehicle functions is the Vehicle Integrated Management System (VIMS). VIMS provides information to managers for the control and maintenance of base vehicles using batch processing, that is, the intermittent processing of information input in "batches." The AFDSDC is currently developing an upgraded version of VIMS, the On-Line Vehicle Integrated Management System (OLVIMS), which can provide immediate vehicle information through the use of interactive terminals.

The final major area of transportation responsibility, traffic management, consists of personal property movement and cargo movement. In the personal property section, several MIS's are in use, including the Carrier Evaluation and Reporting System (CERS), the Non-Temporary Storage System (NOTEMPS) and the Traffic Management Workload Reporting and Productivity System (TWRAPS). CERS tracks the performance of commercial household goods carriers, while NOTEMPS helps manage the non-temporary storage program for household goods. TWRAPS is a system under which monthly transportation workload reports are prepared at base-level for use by managers at the major command level. The AFDSDC is also currently developing a new system for use in personal property called the Transportation Operational Personal Property System (TOPPS). Scheduled to replace the three existing personal property systems (CERS, NOTEMPS, TWRAPS), TOPPS is a Department of Defense (DOD)-wide system for the management of household goods shipments (8).

The other section of base-level traffic management, cargo movement, includes the transportation functions of packaging and preservation, inbound and outbound air freight (non-MAC), and inbound and outbound surface freight. This research concentrated on one portion of cargo movement, specifically outbound surface freight, which is the function responsible for processing and shipping outbound government property by surface means. Current MIS's used by all cargo movement functions include the cargo portion of TWRAPS and two related systems to manage DOD cargo shipments: Military Standard

Transportation and Movement Procedures (MILSTAMP) and Military Supply and Transportation Evaluation Procedures (MILSTEP). MILSTAMP "provides policies and procedures required to manage and control the movement of material through the Defense Transportation System" (9:1-1). MILSTEP, on the other hand, provides for the collection, evaluation and redistribution of shipment performance data (10:1-1). Except for the limited use of punched card reporting, current procedures for movement and control of cargo are entirely manual.

Current AFDSDC plans also call for development of one final system, the Transportation Information Library (TIL), which will serve as a repository for transportation management information to be used by OLVIMS, TOPPS and OLCMS.

Statement of Problem

Information needed to manage outbound surface freight, using the On-Line Cargo Movement System, has not been identified.

Justification

As stated previously, current procedures for the movement and control of cargo are predominantly manual. Our field experience working with this system and discussions with AFDSDC personnel (6) indicate time-consuming, inaccurate and often unreliable task performance. Automating the cargo movement information system should reduce these problems and provide outbound surface freight operations the capability to realize potential advantages of current and future automated information systems in base supply. Two such systems, with which an automated cargo movement MIS could interface, are the Logistics Applications of Automated Marking and Reading Symbols (LOGMARS) and Phase IV.

Air Force LOGMARS development initiatives are currently being managed by the Air Force Logistics Command (AFLC). The project, eventually planned for DOD-wide implementation, is a cargo marking system using bar coding, an increasingly popular concept from commercial industry (e.g., product coding system found in supermarkets) (11). Results of the LOGMARS Laboratory and Prototype Test Program, reported by the Joint Steering Group (JSG) for LOGMARS in 1981, estimated total DOD savings of $113.9 million annually when using the bar coding data entry system. Further intangible benefits included:

- o increased data accuracy
- o decreased order and transit time
- o improved productivity (6-500%)
- o reduced documentation requirements
- o increased control of property
- o improved management information
- o reduced training needs
- o decreased inventory levels (12:30).

The JSG concluded that LOGMARS has "great potential, especially in the transportation environment" (12:41).

Phase IV, the other automated information system in base supply, involves the conversion of the present base-level computer systems. The current computer systems are the Univac 1050-II (base supply) and the Burroughs 3500/3700/4700 (other base support). Under Phase IV, these 20-year-old systems are presently being replaced by the state-of-the-art Univac 1100-60 system. With completion of the worldwide hardware replacement, estimated for July 1985, the following improvements over the old systems are expected:

- increased system capacity, allowing greater support through a larger number of remotes
- improved hardware reliability
- faster information processing
- improved on-line capability, providing screen and/or hardcopy output
- electronic interfaces with other functional systems, eliminating the use of punched cards and greatly reducing workload (13).

Under the present manual system, cargo movement functions cannot realize the above-mentioned benefits of such programs as LOGMARS and Phase IV. The OLCMS will provide the automated surface freight/base supply interface necessary for transportation personnel to take advantage of these benefits.

Scope and Limitations

A preliminary study of information needs in cargo movement was required before AFDSDC could develop the OLCMS. This research was directed toward the development of the OLCMS through the establishment of information needs of only one section of cargo movement: outbound surface freight. Further, this research focused on the transaction processing-oriented information system rather than the higher-level management-oriented information system. Finally, due to manpower and time constraints, only two outbound cargo systems were observed during this research effort; therefore, general applicability to similar systems should be carefully analyzed.

Research Objectives

The objective of this research was to assist the Air Force Data Systems Design Center in the development of an automated management information system for cargo movement by identifying the information needs of the OLCMS when processing cargo in outbound surface freight. A systems analysis[1] of the outbound surface freight section accomplished the following subobjectives:

- o Define the current outbound surface freight system.
- o Identify the required decisions/tasks of the system.
- o Determine the information needs for the required decisions/tasks.
- o Outline the general system objectives needed to support known information requirements.

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[1] Systems analysis, treated in greater detail in Chapter II, involves identifying the information needs of the user. The process includes the definition and scope of user problems/needs and the gathering and analyzing of system study facts (5:18-21,198-199).

Overview

The remaining five chapters describe the systems analysis approach used to determine the information needs of outbound surface freight for the On-Line Cargo Movement System. Chapter Two reviews current literature on methodologies of system analysis and the importance of user involvement when establishing any successful MIS. Chapter Three discusses the methods of data collection and the functional models used in determining information requirements. Chapter Four presents models of the current system, while Chapter Five illustrates the proposed automated system. Chapter Six summarizes the research and presents our conclusions and recommendations.

II. Literature Review

Overview

This literature review was conducted using the resources of the Air Force Institute of Technology Libraries, the Defense Technical Information Center, the University of Dayton Roesch Library and the Wright State University Library. The review covered the systems development life cycle, techniques and tools for systems analysis and the importance of user involvement in the development process. This effort familiarized the researchers with current literature for application to a systems analysis of outbound surface freight.

Systems Development Life Cycle

Information systems development is a process which allows for a great deal of creativity. In fact, the only limits to the degree of creativity employed are in the minds of the individual systems analysts and designers. To afford some structure to this basically boundless creative process, the concept of a systems development cycle is used. The systems development cycle, given different names by different authors, provides a framework of steps through which to proceed in developing an information system. The cycle also serves to control the development process by indicating what steps need to be accomplished, what steps have been completed and what steps remain to be done (14:413).

Just as the cycle is given different names by different writers, the various authors also describe the phases or steps differently. This is evident in the following comparison of three of the many cycles advanced in the literature:

A. Systems Development Methodology (5:298)

1.	Systems Analysis:	define user problems/needs; scope system; gather and analyze study facts
2.	General Systems Design:	design system in general terms and outline design alternatives
3.	Systems Evaluation and Justification:	assess personal impact and perform cost/effectiveness analysis
4.	Detail Systems Design:	design system in specific terms
5.	Systems Implementation:	train users; test new system; convert to new system; follow-up to insure system operates as expected

B. Information System Application Development Life Cycle (14:413-414)

1.	Feasibility Assessment:	evaluate feasibility of proposed system and perform cost/benefit analysis
2.	Information Analysis:	determine information needs
3.	System Design:	design processing system and prepare program specifications
4.	Program Development:	code and debug computer programs
5.	Procedure Development:	design procedures and write user instructions
6.	Conversion:	test new system and convert to new system

7.	Operation and Maintenance:	maintain and modify system
8.	Post Audit:	evaluate system effectiveness

C. Systems Life Cycle (15:78)

1.	Inception:	perform initial survey
2.	Feasibility Study:	outline present procedures; propose alternative systems; provide cost estimate of each alternative system
3.	Systems Analysis:	detail existing procedures; collect preliminary data
4.	Design:	design unconstrained ideal system; revise ideal system subject to existing constraints
5.	Specifications:	develop system specifications
6.	Programming:	code and debug computer programs
7.	Testing:	test new system
8.	Training:	train users
9.	Conversion and Installation:	install and convert to new system
10.	Operations:	maintain and modify new system

As can be seen from the three approaches outlined above, although the names and numbers of stages differ between authors, a common general philosophy prevails. Differences appear primarily in amount of detail and number of steps, while basic agreement exists on the order in which activities are completed and the overall need for control in the development effort. Davis categorizes the numerous steps in these approaches into three major phases:

- o definition of the system or application
- o physical design
- o implementation (14:414).

Generally, Davis' first phase of defining the system or application includes: defining the existing system, determining the user's needs and describing the system specifications required to support those needs. His second and third phases, physical design and implementation, were beyond the scope of this research. Our thesis focused on the systems analysis step of information system development, as identified in Davis' first phase.

A commonly accepted approach for accomplishing this first phase, systems analysis, includes three major activities. First, a review of systems documentation reveals how a particular system is theoretically supposed to operate. Next, the operations of the system under analysis are observed to determine how the system actually is functioning. Often, based on these observations, a flowchart of the system is prepared. Flowcharting is a technique which graphically depicts the step-by-step operation of a system. Finally, individuals working within the system are interviewed to determine what shortcomings exist in the present system. This process leads to recommendations to be included in the new or improved system (16). Regardless of the specific approach chosen to perform the systems analysis, many techniques and tools exist to aid the analyst.

Systems Analysis: Techniques and Tools

Methodologies for performing systems analysis involve combinations of many available basic techniques such as: interviewing, questionnaires, observation, documentation review and sampling (17:29). Specific tools employed by analysts in conjunction with these basic techniques include: network modeling, simulation, mathematical modeling, decision tables, charting and structured systems analysis.

Techniques. Interviewing, one of the most common methods of gathering study facts, provides a good starting point for systems analysis. According to Athey, three reasons for interviews are:

- to gather general background information,
- to gather specific information (facts, guesses, estimates) from experts, and
- to gather other information as to competence, feelings, opinions, biases and/or pressures on individuals or groups within the organization (18:12).

Interviewing is a costly method of fact gathering, in terms of both time and money, and care must be taken to avoid the many potential weaknesses inherent in any communication process (17:29-30;19:294).

An impersonal counterpart to the interview, the questionnaire, is applicable when collecting data from many individuals or those who are geographically dispersed. Four limitations of the questionnaire cited in the literature are:

- difficulty in structuring meaningful questions
- long response times

- absence of respondent commitment, resulting in low priority

- inability to directly stimulate respondent, resulting in less thought-out and less detailed answers (5:313;17:32).

Observation is especially effective in defining the existing system, allowing the analyst to determine the what, how, who, when, how long, where and why of current operations (5:318). With respect to the observer-subject relationship, observation can be viewed in three ways:

- Is the observation direct or indirect?

- Is the observer's presence known or unknown?

- Is the observer a participant or nonparticipant? (19:327)

Observation lends itself more to the operational level of organizations, that level where structured decisions are made. Higher levels, where unstructured managerial decision-making occurs, do not lend themselves to observation as easily because of the difficulty in quantifying the decision-making process (5:318;17:34). Other weaknesses include:

- the process is slow and expensive

- observation is limited to learning about current processes

- observation alone does not reveal underlying circumstances

- the observer must be physically present (19:313).

Document examination is another useful technique available to the systems analyst. By examining documents, the analyst can get an overall picture of the organization or functional area. This overall picture might include what is being done, how it is structured, what shortcomings exist, and, possibly, the relative importance of tasks. When used in conjunction with techniques previously mentioned, document examination enhances fact gathering (20:32;5:320).

Sampling, the final basic technique, is primarily used in cases where there is such a large volume of data that it is impractical or impossible to gather it all. Instead, a representative sample of the data is taken, saving both time and money (17:36;5:319-320;18:12;21:244-245).

Tools. Network modeling, the first of six tools discussed, is a graphical representation of activities and events of operational systems. Two widely used network models are Program Evaluation Review Technique (PERT) and Critical Path Method (CPM). PERT is a probabilistic model for defining and controlling the efforts necessary to complete projects within time schedules. CPM, however, is a discrete model providing a range of project durations with an associated range of project costs. PERT and CPM have been used successfully in a number of complex engineering projects. Other network models mentioned by Whitehouse are flowgraph analysis and decision trees (22:9,30-31,162,198;23:307-318).

Simulation is defined by Shannon as:

> the process of designing a model of a real system and conducting experiments with this model for the purpose either of understanding the behavior of a system or of evaluating various strategies (within the limits imposed by a criterion or set of criteria for the operation of the system) (24:2).

Many simulation languages exist, including Graphical Evaluation and Review Technique (GERT) and General Purpose Simulation System (GPSS). Simulation models, which can become extremely complex mathematically, are used to aid in making forecasts or planning decisions (23:165-168).

Another useful tool for the systems analyst, referred to generally as mathematical modeling, employs such techniques as system ranking, optimization, signal theory, matrices and linear and nonlinear systems. A major weakness of mathematical modeling is the high level of abstraction involved. However, from a computational standpoint, mathematical models may be superior, especially when modeling large-scale systems (22:9;25:7-12).

Decision tables and tabular representations of the decision-making process are used to facilitate communication between users and analysts. Decision tables are useful in communicating complex logic in a condensed, concise form and can be updated easily. The key criterion for applying decision tables is the existence of an - if this condition, then apply this rule - situation (15:128-130;5:333).

Charting, a graphical means of depicting data, presents a picture of a flow of work (23:276;26:95;5:320). Fitzgerald categorized charting as follows:

- o Activity charting: pictures the flow of work through a system (flowchart)
- o Layout charting: pictures the physical area under analysis (shop layout chart)

- o Personal relationship charting: pictures chain of command and position duties and responsibilities (organization chart)

- o Statistical data charting: pictures statistical data in an understandable form (tables or graphs) (23:276).

Although all four categories of charts are useful graphic aids for systems analysis and design, activity charting and specifically flowcharting is, perhaps, the most important. Flowcharting represents relationships between elements in a system and simplifies complex systems by allowing the analyst to break a problem into smaller workable parts. Flowcharts are also useful in communicating with users and as a training aid (15:126;23:277;5:325).

A final tool, structured systems analysis, is built upon the top-down decomposition of a system. This tool takes an overall problem or system and, starting at the highest level, breaks it into component parts and continues until all levels are clearly defined. The structured, top-down approach to systems analysis results in a functional diagram resembling a tree (17:36-37;5:306-307). Sound logic is the primary advantage of structured systems analysis. The top-down, structured approach clearly describes the reasoning and logic followed in analyzing a system (5:306;23:155). Several structured, top-down approaches to systems design are available. Three representative approaches are:

- o Integrated Computer-Aided Manufacturing (ICAM) System Development Methodology. The definition/needs analysis phase of this methodology, $IDEF_0$ provides a blueprint defining the fundamental functional relationships within a manufacturing environment (27:13).

- Structured Requirements Definition. The emphasis in this approach is on the definition of system outputs in two phases. In the first phase, logical definition, an ideal functional definition of the system outputs is completed. Physical requirements definition, the second phase, incorporates unique user constraints and characteristics (28:124,184).

- Structured Systems Analysis. This technique is based on the concept of building systems by successive refinements from producing an overall data flow scheme to designing modular structures. The tools used in structured systems analysis prepare a functional specification that:

  - is well understood and fully agreed to by users,

  - sets out the logical requirements of the system without dictating a physical implementation, and

  - expresses preferences and trade-offs (20:6).

Of the structured analysis approaches reviewed, Structured Systems Analysis by Gane and Sarson appeared to be most applicable to this research. As Towner observed, $IDEF_0$ required a high degree of user sophistication and extensive training (29:8). In addition, Stillwell and Morgan encountered numerous difficulties is using $IDEF_0$ as the approach was originally designed to model a manufacturing process (30:89-91). Orr's Structured Requirements Definition methodology starts with outputs and works backwards to analyze a system. We felt, however, that a forward-looking, process/flow analysis was more appropriate for outbound surface freight. Therefore, because it was relatively easy to learn and more applicable to our system, Structured Systems Analysis was chosen.

User Involvement in System Development

Successful development and implementation of a management information system is dependent on its ability to support an organization's decision making activity (31:16). Present literature generally notes user concerns toward the poor quality of information generated and the dissatisfaction with their management information systems (32:18;33:6;31:971).

Early research by Ackoff emphasized the overload of irrelevant information and output produced by many systems. He indicated that much of the data (not information) was extraneous to the managers' needs and was received in quantities beyond the capability of the user to absorb. He further stated that:

> Of those (computerized management information systems) I've seen that have been implemented, most have not matched expectations and some have been outright failures (34:147).

Extensive research assessing user views on computer-based information systems conducted by Lucas in 1975 involved a survey of 2,000 users in sixteen organizations. He summarized manager dissatisfaction as follows:

> According to this research, users do not understand much of the output they receive; there is duplication of input and output, and changes are frequently made in systems without consulting users. Because of inaccuracies, users often discount all the information provided by a system. Many users complain of

information overload, massive amounts of data are provided which cannot be digested by the decision-maker. There are also many complaints about the difficulty of obtaining changes in existing systems. A number of users report that they do not actually use the information provided by an information system. Many feel that computer-based information systems are not worth the time or cost to develop and that the organization would be better off without them (35:2-3).

Several studies have resulted in contradictory findings on the issue of user dissatisfaction with MIS. Adams' 1975 research findings, following a series of personal interviews of managers from ten major corporations, concluded that managers are clearly satisfied with their systems and that major improvements in the system were not needed (36:344). Results of the Minnesota Experiments conducted by Dickson, Senn and Chervany in 1977, supported Adams' conclusions (37:921). More recently, Senn surveyed sixty managers using a mail questionnaire getting similar results to those of Adams and the Minnesota Experments. He concluded:

- Users were satisfied with precision and accuracy of information produced.

- Users wanted better quality information rather than more information, although independently they wanted both.

- Managers surveyed demonstrated satisfaction with the repetitiveness of reports being received and were not seeking drastic changes in this respect.

- Quality of the information system was satisfactory in the sense that users found the information being produced to be highly useful and relevant.

- Progress has been made in development of new systems to overcome shortcomings that users felt in the past. Users were involved in the development process through joint user/systems staff project teams.

- o Overall satisfaction was high (33:10-11).

Senn noted very important areas of concern that managers pointed out in the study:

- o Managers were using less than half of the information they received from computer-based information systems.

- o Although needed information exists, it was not available due to access and formatting problems (33:11).

User involvement in the development process is presently encouraged and believed to be a major factor in the successful implementation and user satisfaction of management information systems (38:15;39:73;31:968). Expected benefits noted by Bjorn-Anderson and Hedberg of greater user involvement included:

- o more accurate assessment of user information requirements,

- o prevention of costly system features that were unacceptable to users,

- o greater user acceptance and support of the system,

- o improved user understanding of the system,

- o granting of democratic rights of organization members (40:134-135).

Studies further indicated that earlier user involvement increases the likelihood of MIS success. Holland found that interviewees (33 managers and non-supervisory personnel from three large complex organizations) felt that users should be involved in systems design either by a high degree of user-designer interaction during the system's design stage or by early user inputs to allow the designer to meet user requirements (38:15). Zmud's review of empirical research in MIS noted that early involvement in MIS was positively correlated to user satisfaction while there was a negative association between later involvement and MIS satisfaction (31:972-973).

The relationship between user attitudes and MIS success has been a topic of study by several researchers. Zmud concluded that, in general, researchers noted:

> Preconceived attitudes toward MIS are associated with MIS usage to a much greater extent than MIS satisfaction. Usage has been positively associated with attitudes regarding the potential of a MIS, the urgency of a MIS, the extent of top management support for a MIS, and the quality of the MIS staff. Regarding MIS satisfaction, only a positive association with attitudes of top management support and mixed results regarding MIS potential have been observed (31:972-973).

Many of the problems associated with MIS development and implementation - information overload, irrelevant information, access and formatting complexities, user dissatisfaction and information not understood by users - can be alleviated through user-analyst interaction early in the systems analysis phase. In our efforts to avoid these problems, user involvement was the foundation of methodology for accomplishing this systems analysis of outbound surface freight. Chapter III outlines our methodology.

III. Methodology

Overview

Our methodology was designed to solve the problem of detailing the previously unidentified information needs of outbound surface freight necessary in the development of the OLCMS. Using a combination of several of the techniques and tools discussed in Chapter II, our methodology addressed the problem by accomplishing the following subobjectives:

- o Define the current outbound surface freight system.
- o Identify the required decisions/tasks of the system.
- o Determine the information needs for the required decisions/tasks.
- o Outline the general system objectives needed to support known information requirements.

The five selected techniques and tools - documentation review, interviews, observation, flowcharting and structured systems analysis - were applied within the commonly accepted three-step approach to performing systems analysis as outlined in our literature review. The remainder of this chapter details the specific application of each component of our methodology in the accomplishment of our subobjectives.

Systems Analysis Methodology

Step One: Determine how an outbound surface freight system is theoretically supposed to operate. The approach to this step was twofold: preliminary interviews and documentation review.

First, experts in the field were interviewed to gather general background information and to get advice on appropriate documentation to review. The interviewees were:

Mr. Ronald Bird
Transportation Officer, 2803 ABG
Newark AFS (NAFS), OH

Mr. Chuck Dahle
Traffic Management Officer, Transportation Branch
Wright-Patterson AFB (WPAFB), OH

Mr. Don Huggins
Surface Freight Unit Chief, Transportation Branch
WPAFB, OH

CMSgt. Howard Jasper
NCOIC, Exercise Branch, HQ AFLC
WPAFB, OH

Lt. Col. David J. Porter
Chief, Transportation Branch
Logistics Squadron
WPAFB, OH

The interviewees were selected based on their expertise and years of experience in surface freight.

According to Ross, et al., the following four types of interviews may be conducted to gather information during systems analysis:

- o Fact finding: for understanding both the theoretical and actual outbound surface freight operations

o	Problem identification:	for identifying current system shortcomings and to aid in defining requirements of the new or improved system
o	Solution discussion:	for specifying future capabilities which will improve the existing system
o	Author/ reviewer talk session:	for resolving problems encountered during systems analysis (41:2-1).

The preliminary interviews conducted in this first step were the fact-finding type.

All interviews in this systems analysis were conducted using a team approach. One team member directed the interview while the other team member documented the experts' responses. Personal interviews were also tape recorded, and copies of the tapes were offered to the interviewees. These recordings insured accurate recall of interviewee comments for later use in model development. Finally, four interview guides were developed to cover the different purposes of interviews conducted at various stages of our systems analysis (see Appendix A).

The second approach used to determine how an outbound surface freight system theoretically operates was documentation review. The following regulations, obtained from Wright-Patterson AFB sources, were reviewed:

DODM 4000.23	Military Supply and Transportation Evaluation Procedures (MILSTEP)
DODR 4500.32	Military Standard Transportation and Movement Procedures (MILSTAMP), Vol. 1 (Policies and Procedures)
AFR 75-1	Transportation of Material

AFM 75-2	Military Traffic Management Regulation
AFR 75-15	Reports for Military Transportation Requirements

Step Two: Define the existing outbound surface freight system. Four techniques and tools were used in this step: observation, documentation review, flowcharting and interviews. These four approaches were applied in our studies of the WPAFB and NAFS Outbound Surface Freight Sections. While the optimum sample for our research would have been to study all Air Force outbound surface freight sections worldwide, this, of course, was not possible. The next best approach to achieving our objectives - studying a representative outbound surface freight section in each Air Force major command - was also not practical due to resource constraints. In order to achieve the desired degree of detail in studying the complexities of an outbound surface freight function, we limited our research to two locations rather than cursory treatment of several operations. Therefore, our selection of WPAFB and NAFS was based on ease of access and overall cost savings.

The first approach to defining the existing system, observation, involved our physical monitoring of outbound surface freight operations on several occasions. Our objective in observing outbound surface freight was to gain an understanding of the existing system by determining what tasks were accomplished in the processing of cargo for outbound shipment. Understanding the existing system helped identify shortcomings in the present MIS and areas for improvement with eventual integration into the OLCMS.

Another approach applied to this step was documentation review. Whereas the documentation reviewed earlier was general in nature, this step required more detailed review of specific systems workload records and completed shipping documents. The particular reports and forms reviewed were:

Transportation Workload Reporting and Productivity System records

DD Form 1085	Domestic Freight Routing Request and Order
DD Form 1149	Requisition and Invoice/Shipping Document
DD Form 1348-1	DOD Single Line Item Release/Receipt Document
DD Form 1384	Transportation Control and Movement Document
DD Form 1384-1	Intransit Data Card
DD Form 1385	Cargo Manifest
DD Form 1387	Military Shipment Label
DD Form 1387-2	Special Handling Data/Certification
AF Form 127	Traffic Transfer Receipt
SF 361	Discrepancy in Shipment Report
SF 363	Discrepancy in Shipment Confirmation
SF 1103	U.S. Government Bill of Lading

The third approach used in this step of the methodology was interviews. Using a second fact-finding interview guide (see Appendix A), surface freight supervisors and outbound surface freight technicians were questioned to determine the decisions/tasks required to process outbound cargo. The following people were interviewed:

Mr. Paul Akers
Blocking and Bracing Foreman
Surface Freight Unit, Shipping and Receiving
WPAFB, OH

Mr. Robert Allen
Traffic Management Specialist
Transportation Services, Shipment Planning
NAFS, OH

Mr. Ron Bird
Transportation Officer, 2803 ABG
NAFS, OH

Ms. Margaret Chapman
Shipment Clerk
Surface Freight Unit, Shipping and Receiving
WPAFB, OH

TSgt. Daniel W. Cooper
Freight Traffic Specialist
NCOIC, Transportation Services
WPAFB, OH

Ms. Dolly Hairston
Traffic Management Specialist
Surface Freight Unit, Shipment Planning
WPAFB, OH

SRA Patty Kowaleski
Freight Traffic Specialist
Shipping Services Sub-Unit, Documentation and Billing
WPAFB, OH

Mr. George McAlpine
Freight Rate Assistant
Transportation Services, Documentation and Billing
NAFS, OH

Ms. Dorothy McCaughey
Freight Rate Assistant
Surface Freight Unit, Shipment Planning
WPAFB, OH

SSgt. Chris Morris
Freight Traffic Specialist
Shipping Services Sub-Unit, Documentation and Billing
WPAFB, OH

Mr. Ken Nichols
Foreman, Packaging and Preservation
WPAFB, OH

Mr. James O'Quinn
Chief, Transportation Services
NAFS, OH

Ms. Sylvia Roberts
Shipment Clerk/Data Transcriber
Shipping Services Sub-Unit, Data Transcribing
WPAFB, OH

Ms. Nancy Sevier
Shipment Clerk
Surface Freight Unit, Shipment Planning
WPAFB, OH

Sgt. James Williams
Freight Traffic Specialist
Surface Freight Unit, Shipping and Receiving
WPAFB, OH

Flowcharting, the final approach applied in defining the existing system, provides a pictorial representation of the sequence of operations and/or the flow of information through a process or system (42:167). This tool uses specialized symbols to illustrate the process steps or information flows of a system. Information gathered through observation, documentation review and interviews earlier in this step of our methodology was used to prepare two types of flowcharts depicting the existing outbound surface freight system.

The first of these two types, a physical flowchart, presents the sequence of operations in a system. In preparing a physical flowchart, a block diagram format was used, where each block represented a cargo processing activity and the arrows between blocks indicated cargo flow.

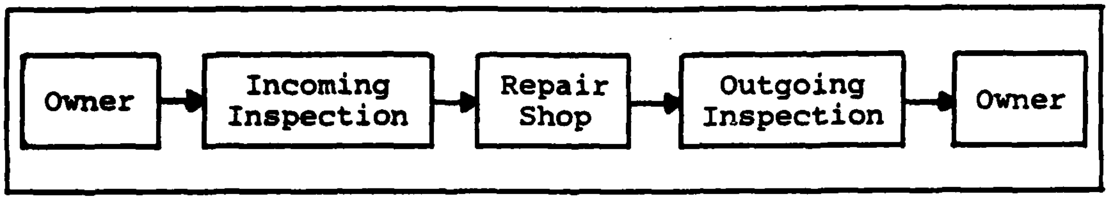

Fig 2. Physical Flowchart Example

Figure 2 illustrates a physical flowchart for a vehicle repair operation. The flowchart depicts receipt of the vehicle from the owner, followed by the incoming inspection, repair, outgoing inspection and, finally, return of the vehicle to the owner.

The second type of flowchart, a document flowchart, details the flow of documents relating to a particular transaction through an organization. While Figure 3 shows the specialized symbols used in document flowcharting, Figure 4 contains a simple document flowchart.

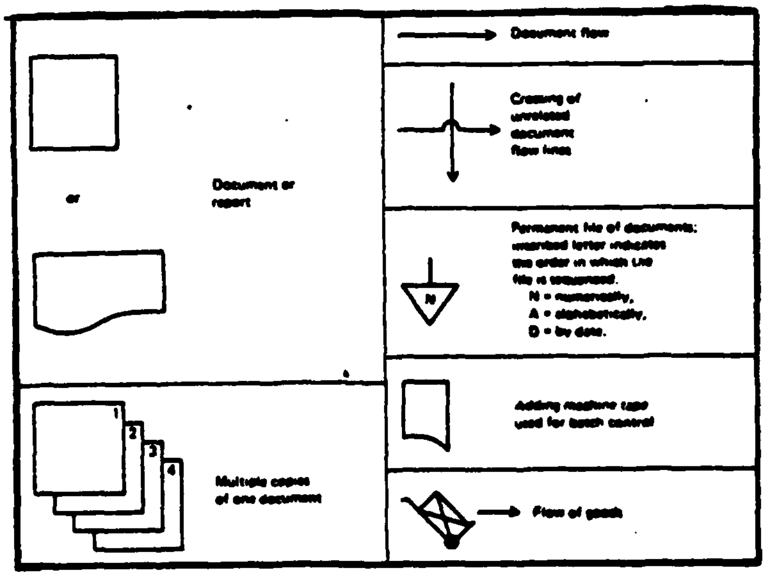

Fig 3. Symbols for Document Flowcharting Source: (42:332)

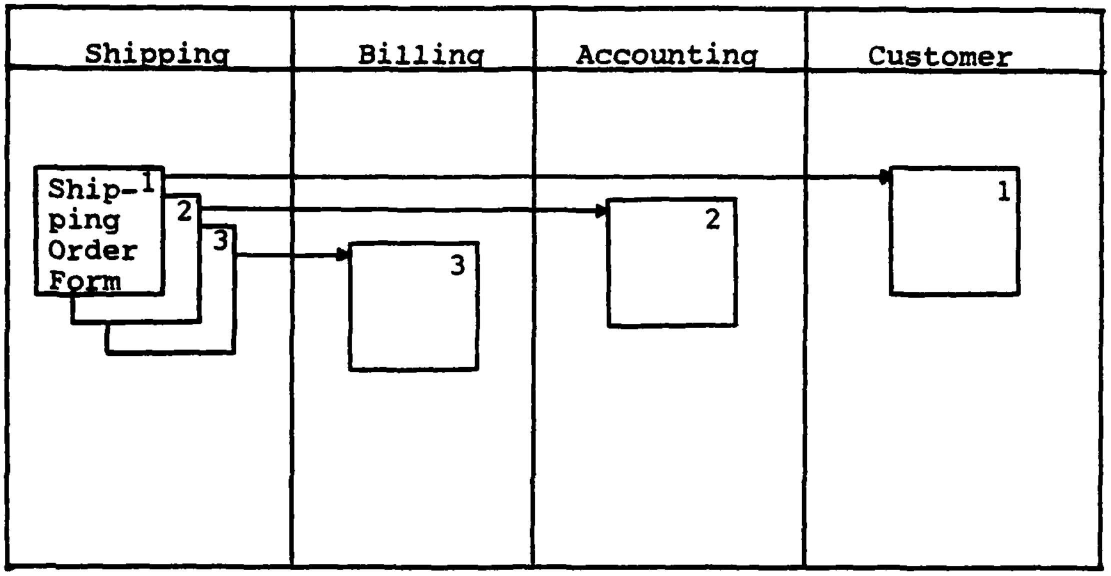

Fig 4. Document Flowchart Example

This simple example shows the distribution throughout an organization of a three-part shipping order form. The shipping order form is prepared in the shipping department and distributed as follows: copy one is mailed to the customer, copy two is forwarded to the accounting department and copy three is sent to the billing department.

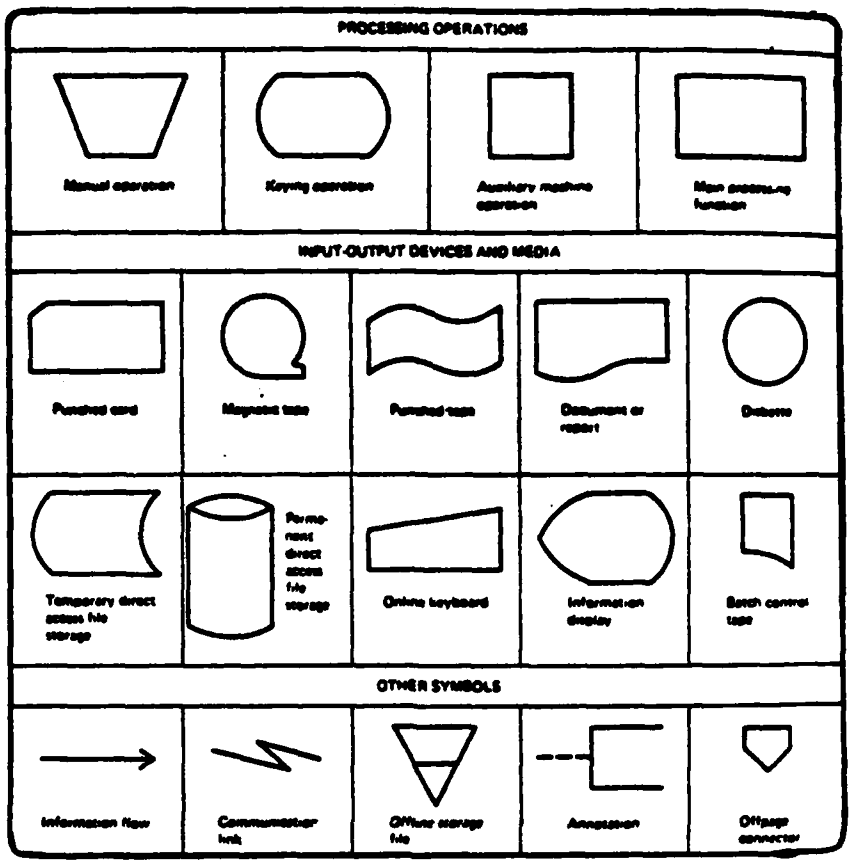

Fig 5. Symbols for Systems Flowcharting Source: (42:168)

A third type of flowchart, normally used in systems analysis, is the systems flowchart. A systems flowchart shows the hardware configuration of a system. The specialized symbols used in this type of flowchart are shown in Figure 5.

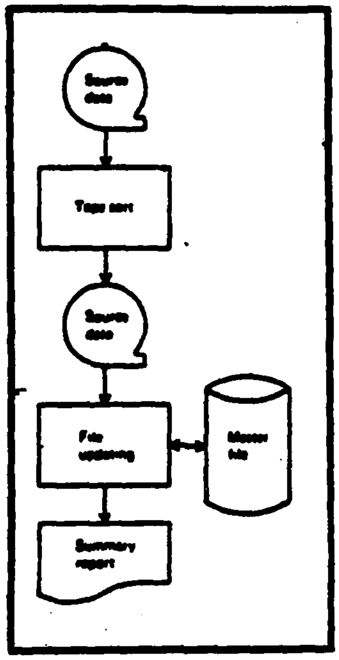

Fig 6. Systems Flowchart Example Source: (42:173)

Figure 6 illustrates a simple example of a systems flowchart. This particular example illustrates the processing of source data on magnetic tape for updating a master file stored on a magnetic disk. First, the source data (e.g., records, accounts) stored on tape are sorted by the central computer and returned to magnetic tape. Then the sorted source data are processed by the central processing unit to update the master file stored on a magnetic disk. Finally, a summary report is produced as an output of this file-updating process.

As noted earlier, a systems flowchart is commonly used in systems analysis. However, because our research revealed minimal existing hardware in outbound surface freight, a systems flowchart was not prepared.

<u>Step Three: Recommend new or improved system based on identified information needs</u>. Interviews and structured systems analysis were employed to accomplish this final step of systems analysis.

Interviews were again conducted, the purpose this time being 1) to identify shortcomings in the present system, and 2) to identify proposed solutions for incorporation in the new or improved system. A problem identification/solution discussion interview guide was used for the interviews in this step (see Appendix A). The interviewees were:

Mr. Paul Akers
Mr. Robert Allen
Mr. Ron Bird
Ms. Margaret Chapman
TSgt. Daniel Cooper
Ms. Dolly Hairston
Mr. Don Huggins
SRA Patty Kowaleski
Mr. George McAlpine
Ms. Dorothy McCaughey
SSgt. Chris Morris
Mr. Ken Nichols
Mr. James O'Quinn
Ms. Sylvia Roberts
Ms. Nancy Sevier
Sgt. James Williams

The pictorial representation of the new/improved system came next. Structured systems analysis, a top-down systems model, showed the logical flow of outbound surface freight without prescribing actual physical implementation. Four tools were used in this structured methodology: logical data flow diagram (DFD), data dictionary, process logic and data stores.

A logical data flow diagram, the first tool, uses four symbols (see Figure 7) to represent a system such as outbound surface freight. An overall DFD can be decomposed into explosions of processes known as detailed DFD's for a clearer understanding of a system's functional specification. The DFD shows the sources and destinations of data, identifies and names the logical functions, identifies and names the groups of data elements that connect one function to another, and identifies the data stores accessed (20:23).

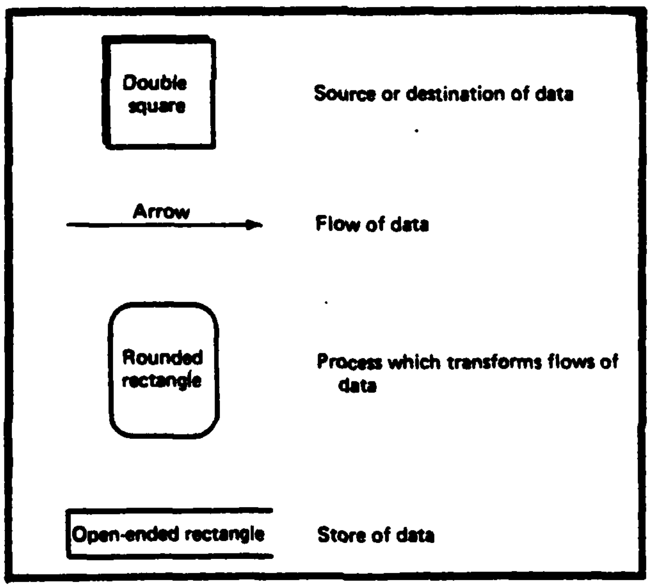

Fig 7. Data Flow Diagram Symbols Source: (20:9)

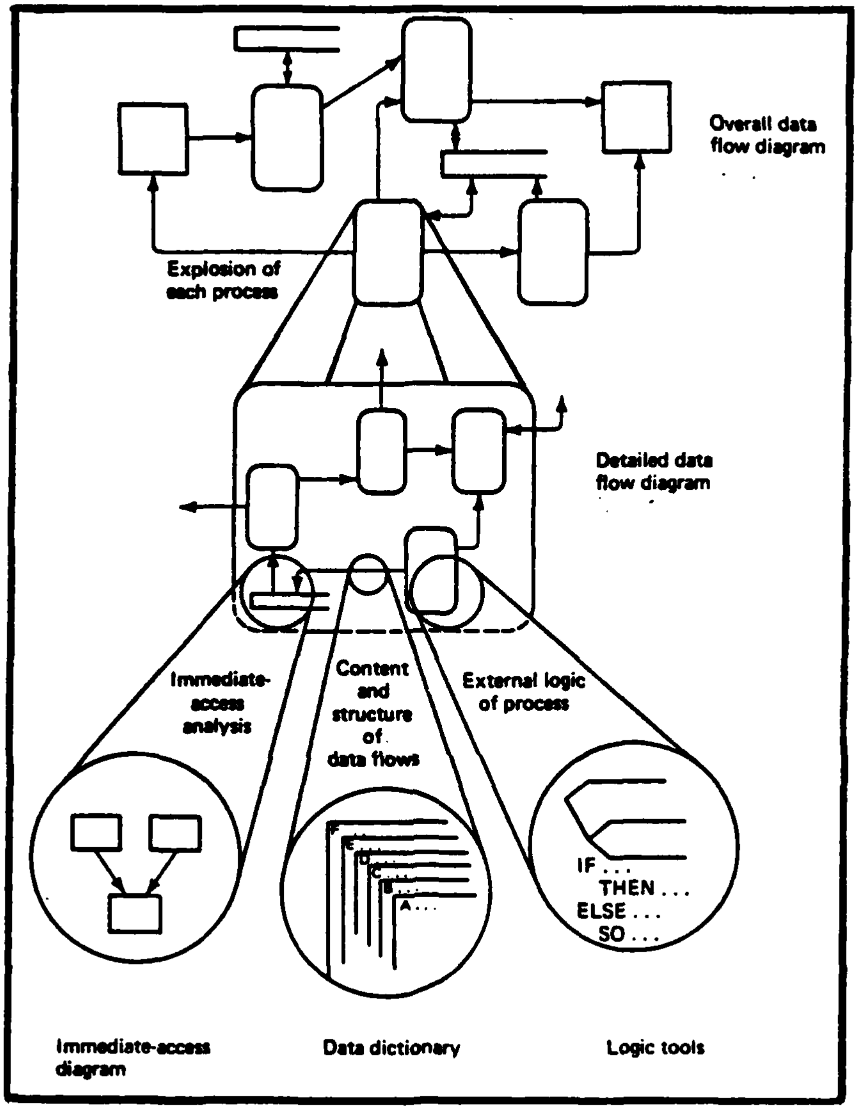

Fig 8. Components of the Logical Model Source: (20:23)

Figure 8 illustrates the components of a logical model.

The second tool in the process is a data dictionary. Each of the data elements in the data flow are given meaningful names, defined and organized in the data dictionary for easy reference during the structured systems analysis. After the elements are defined, an exploration of the operations within the processes, the third tool, called defining the logic of the processes, is completed. Decision trees and structured English are the techniques representing the policies and procedures in the internal and external logic of processes. External logic is concerned with business policy, procedures or clerical rules, while internal logic specifies the way the computer implements these policies, procedures and rules (20:17). Defining the contents and immediate access of data stores is the fourth and final tool in structured systems analysis. The DFD and data dictionary were the tools needed for our portion of the systems analysis of outbound surface freight.

The tools are incorporated into the structured methodology that includes an initial study, a detailed study, defining a "menu" of alternatives, using the "menu" to get commitment from users, refining the physical design of the new system, and implementation of structured systems analysis. For this research, only the first three steps were completed.

The initial study, in deciding to do the systems analysis, answered the following questions:

- o What is wrong with the current situation?
- o What improvement is possible?
- o Who will be affected by the new system (20:155)?

The previous two steps of our methodology (defining the theoretical and existing systems) comprised the detailed study, while defining the "menu" of alternatives included the use of the DFD and data dictionary in producing a new system from the limitations of the current system.

All these steps require user-analyst interaction to insure that the new system provides the greatest payoff for the most people and fits into the overall plan for the development of data processing in the organization (20:155). As a means to achieve this, author/reviewer interview talk sessions were conducted with experts in the field (reviewers) to resolve any problems encountered and verify model accuracy. The interviewees were:

Mr. Paul Akers
Mr. Ron Bird
Ms. Margaret Chapman
TSgt. Daniel Cooper
Mr. Chuck Dahle
Ms. Dolly Hairston
Mr. Don Huggins
SRA Patty Kowaleski
Ms. Dorothy McCaughey
SSgt. Chris Morris
Mr. Ken Nichols
Mr. James O'Quinn
Lt. Col. David Porter
Ms. Sylvia Roberts
Ms. Nancy Sevier
Sgt. James Williams

Summary of Methodology

The three-step methodology outlined above was designed to achieve the subobjectives of our research through the use of five tools and techniques, as described in Table 1 below.

TABLE I

Application of Systems Analysis Tools and Techniques to Research Subobjectives

	Research Subobjectives			
Tools and Techniques	One	Two	Three	Four
Interviews	X	X	X	X
Documentation Review	X	X		
Observation	X	X		
Flowcharting	X	X		
Structured Systems Analysis	X	X	X	X

The remaining chapters present the results of the application of this methodology in a systems analysis of outbound surface freight.

IV. Functional Models of the Present System

Overview

This chapter details the results of our research of the present outbound surface freight systems at Wright-Patterson Air Force Base, Ohio and Newark Air Force Station, Ohio. The two systems are discussed in separate sections, with WPAFB treated first in detail and NAFS discussed next in terms of how their outbound surface freight procedures differ from those at WPAFB. Each section includes a description of the organization, physical and document flowcharts and a brief statement regarding the hardware configuration of the existing system. The chapter concludes with a section outlining the major problems associated with the existing systems as identified through our research.

Wright-Patterson AFB Models

Wright-Patterson AFB, a major AFLC installation located in Fairborn, Ohio, is the site of AFLC Headquarters and numerous major tenant organizations.

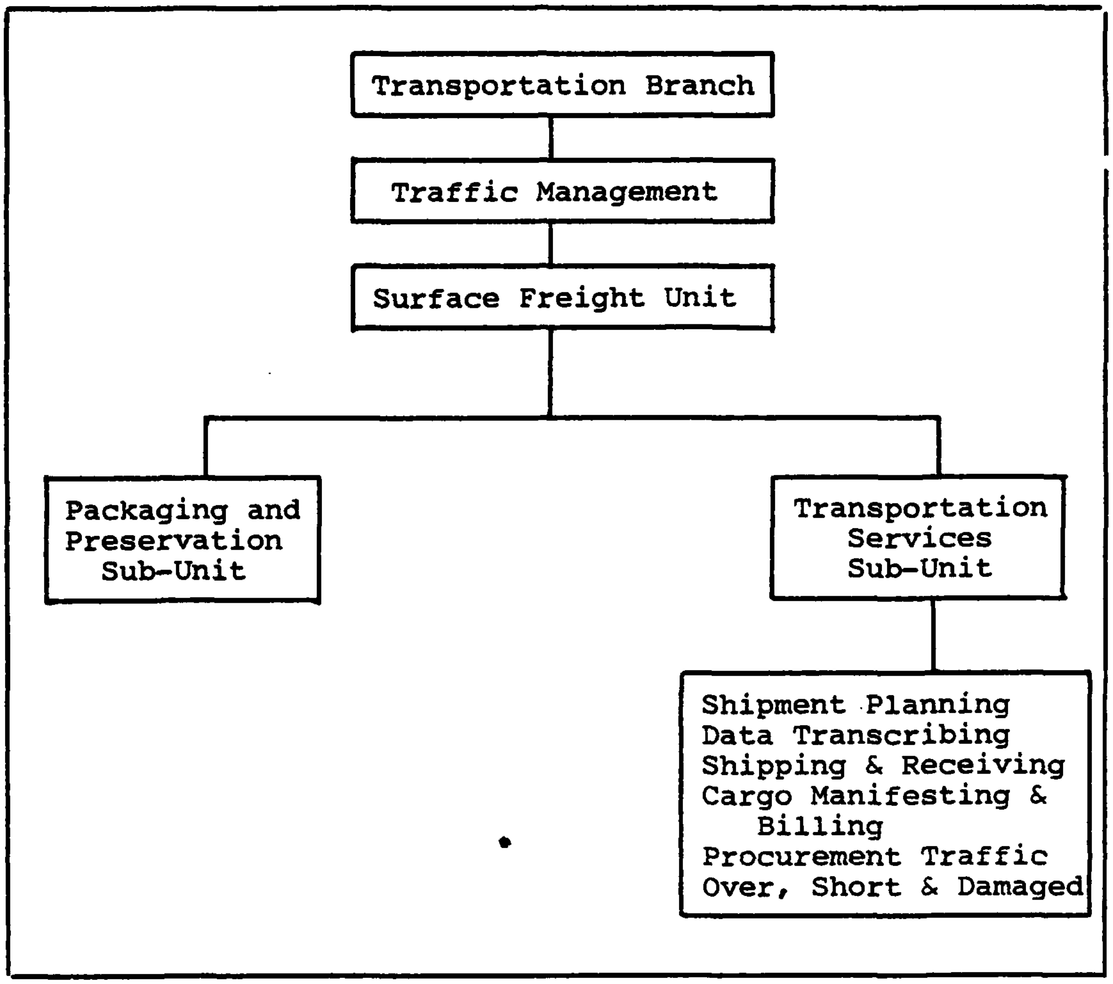

Fig 9. Organization of Wright-Patterson AFB Surface Freight Unit

The WPAFB surface freight function is organized as depicted in Figure 9.

The WPAFB Surface Freight Unit has an extremely diverse mission, supporting not only base shippers and receivers of cargo but also those throughout a large geographical region which includes all of Ohio, Indiana and West Virginia and parts of Wisconsin, Illinois, Kentucky, Pennsylvania, New York and Tennessee. This large geographical area of responsibility comes as a result of WP's designation as the originating or destination station on the Air Force's Logistical Airlift (LOGAIR) System [a nationwide dedicated military airlift system composed of several round-robin routes originating and ending at AFLC's five Air Logistics Centers (ALC's)]. That is, LOGAIR shipments originating in those states mentioned above are first shipped to WPAFB for onward movement via the LOGAIR System. Likewise, LOGAIR shipments destined for the states mentioned above exit the LOGAIR System at WPAFB and are shipped onward to final destination most often by surface means. These types of shipments, which just "pass through" the WPAFB Surface Freight Unit, are known as transshipments and account for roughly two-thirds of total shipments handled. The remaining one-third of shipments handled originate at WPAFB and are known as originating or mission shipments.[2]

An offshoot of the LOGAIR System, unique to WPAFB and the ALC's, is the Surface Transportation System (STS). The STS was developed to relieve the LOGAIR System of a significant cargo backlog by moving lower priority air-eligible

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[2] The reader is reminded here that this research focused on outbound surface shipments; therefore, inbound shipments and those moving by airlift generally were beyond the scope of this project. However, because a significant portion of the outbound surface shipments handled at WP are those exiting the LOGAIR System for onward movement by surface means, the above explanation of the LOGAIR System and transshipments was deemed necessary.

cargo via contract commercial truck between specified points. Of interest to our research were the two STS runs originating at WPAFB moving cargo on a weekly basis to Oklahoma City ALC (Tinker AFB, OK)/San Antonio ALC (Kelly AFB, TX) and Warner Robins ALC (Robins AFB, GA).

With an understanding of the mission, organization, cargo systems and terms associated with the WPAFB Surface Freight Unit, the physical flow of cargo through that unit can now be understood (see Figure 10, page 46). Cargo initially arrives at the incheck point. Mission shipments are received from originating shippers, while transshipments are delivered either by air freight terminal personnel (for shipments exiting the LOGAIR System at WPAFB) or by a transportation carrier (for shipments moved to WPAFB for entry into the LOGAIR System). After the shipment is inchecked, the cargo moves to a temporary holding area while routing is being determined and preparation of shipment documentation begins. While shipment routing and documentation efforts continue, the cargo moves to the packaging and preservation section where it is packed, labeled and made ready for movement. Whereas most mission shipments require at least some packaging, most transshipments do not require repackaging. Exceptions to this are classified transshipments, those arriving damaged and those departing by Parcel Post or United Parcel Service (UPS). After packaging is completed, the shipments are moved into outbound cargo bays with mission

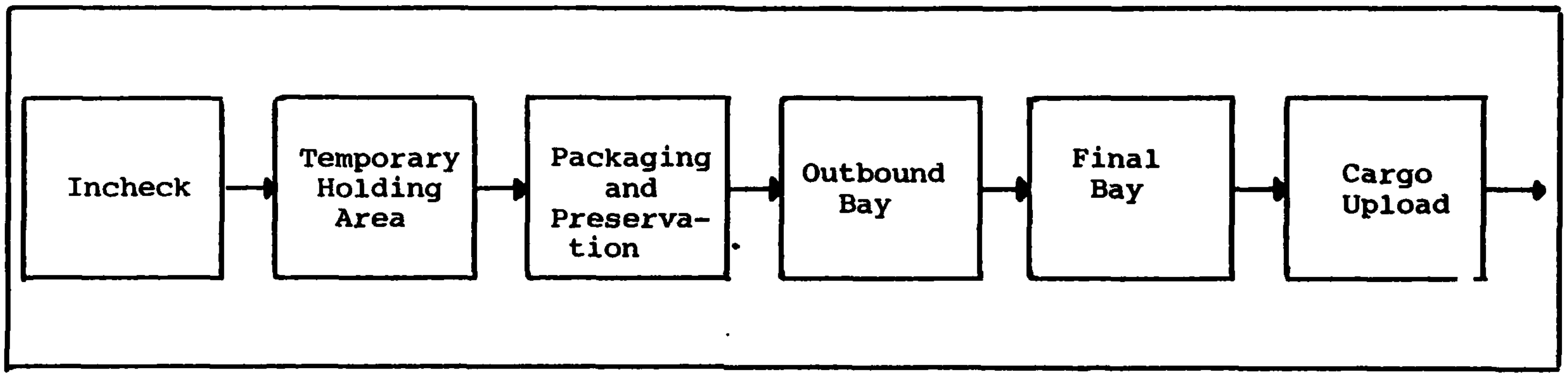

Fig 10. Wright-Patterson AFB Physical Flowchart

cargo sorted by priority and mode of carriage and transshipments sorted as to destination. Following the completion of all shipping documentation, the cargo is moved to a final bay where it awaits carrier pickup. Once the carrier arrives, the cargo is uploaded and the shipment departs.

While Figure 10 and the above narrative describe the physical movement of the general or routine shipment, several types of shipments do not follow this normal flow. STS cargo, which consists mainly of transshipments of construction materials from a depot in Columbus, Ohio, is placed directly into a STS destination bay where it remains until carrier pickup. Classified shipments, assigned to specific individuals for control as they are moved through the unit, involve no temporary holding area. Should holding of classified shipments for any period of time become necessary, they are placed in a secure vault. The highest priority shipments (known as MICAP or 999 shipments) involve no temporary holding area and are moved directly to the packers. These shipments are hand-carried through the system as much as possible. Hazardous cargo shipments (e.g., flammables, oxidizers, corrosives, etc.) are bayed separately in hazardous cargo bays. Finally, some shipments, such as outsize cargo and ammunition, are never physically moved through the Surface Freight Unit; rather, only the shipment documents move through the system while the cargo is picked up wherever it is located.

In addition to grasping the physical flow of cargo, the reader must also understand the flow of shipment documentation in order to fully comprehend the present outbound surface freight system. Figure 11 (see page 51) illustrates this document flow for a mission shipment moving on a Standard Form 1103, U.S. Government Bill of Lading (GBL).[3] The letters in the figure are keyed to the following narrative.

The flow of documents begins when the shipper delivers to the incheck function the materiel and eight copies of either a DD Form 1348-1, DOD Single Line Item Release/ Receipt Document, or a DD Form 1149, Requisition and Invoice/ Receipt Document (hereafter referred to as "shipping document") (A). The first copy of this shipping document is annotated by incheck personnel indicating receipt of the property for shipment and is returned to the shipper (B). Copies six (6) through eight (8) of the shipping document are then sent to Packaging and Preservation (C), and copies two (2) through five (5) are forwarded to Shipment Planning (D). While copies 2 through 4 of the shipping document are held in suspense in Shipment Planning, copy 5 is sent to Packaging and Preservation (E). The actual pieces, weight and cube of the shipment are entered on copy 5, which is sent back to Shipment Planning (F). Shipment Planning next prepares and forwards to

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[3] Although transshipments are more common at WPAFB, the mission GBL shipment was chosen to illustrate document flow because it is generally the most common type of shipment at most Air Force bases. Also, Figure 14, Newark AFS Document Flowchart, depicts a document flow very similar to that of WPAFB transshipments. The reader is also directed to Figure 3 for an explanation of the symbols used in document flowcharting.

Packaging and Preservation a DD Form 1387, Military Shipment Label (G). Now that the shipment has been packed and the routing determined, copies 6 through 8 of the shipping document and the DD Form 1387 are attached to the materiel (H), which is then forwarded to Shipping and Receiving (I). Copies 2 through 5 of the shipping document, with actual pieces, weight and cube annotated, are then sent to Documentation and Billing (J).

The Documentation and Billing Section uses copies 2 through 5 of the shipping document to prepare a GBL in nine (9) copies. The first seven copies of the GBL are forwarded to Shipping and Receiving (K), with copies 8 and 9 going to Data Transcribing to be held in suspense (L). Copies 2 through 5 of the shipping document are also sent to Data Transcribing as suspense copies (M). Copies 1 through 4 of the GBL (O) and the materiel, with copies 6 through 8 of the shipping document and the DD Form 1387 attached (P), all go to the carrier. After the carrier signs for the materiel on copies 5 through 7 of the GBL, these copies are forwarded from Shipping and Receiving to Data Transcribing (Q).

At this stage of the document flow, all remaining copies of shipment paperwork have been forwarded to Data Transcribing, the point from which the documents are distributed. Copies 2 through 5 of the shipping document have been held in suspense in Data Transcribing awaiting the return of signed copies 5 through 7 of the GBL, indicating the shipment has been picked up by the carrier. Once these signed copies of the GBL are returned, copy 2 of the shipping document is filed numerically by transportation control number (TCN), a number which identifies a specific shipment (R). Copy 3 of the shipping document along with copy 6 of the GBL and an intransit data card (IDC), a keypunched card prepared in Data Transcribing used as an aid in compiling shipment statistics, are all forwarded to the consignee (S). Copy 4 of the shipping document is attached to copy 7 of the GBL, and the two documents are filed numerically by GBL number in the property shipped file (T). The final copy of the shipping document, copy 5, is then sent back to the shipper as confirmation that the shipment has moved (U). Copy 5 of the GBL, the last of the three copies signed by the carrier, is forwarded to Military Traffic Management Command (MTMC), fulfilling a regulatory requirement that they receive a copy of all Air Force GBL's (V). Finally, two remaining copies of the GBL, which have been held in suspense since the bill was prepared, are used internally. Copy 8 is retained for local finance queries (W), and copy 9 is kept as a certified copy to insure payment in the event the original GBL is lost or destroyed (X).

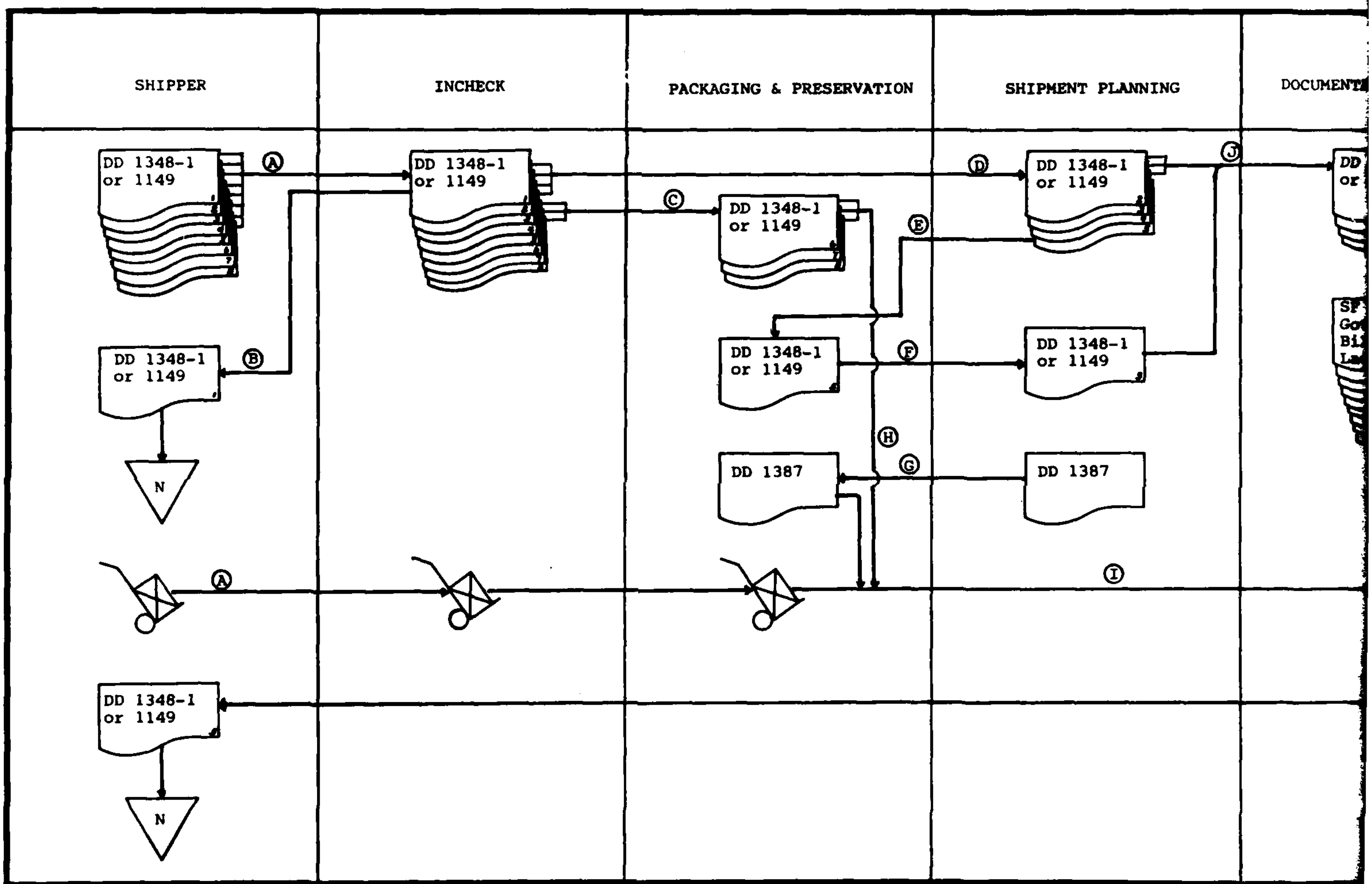
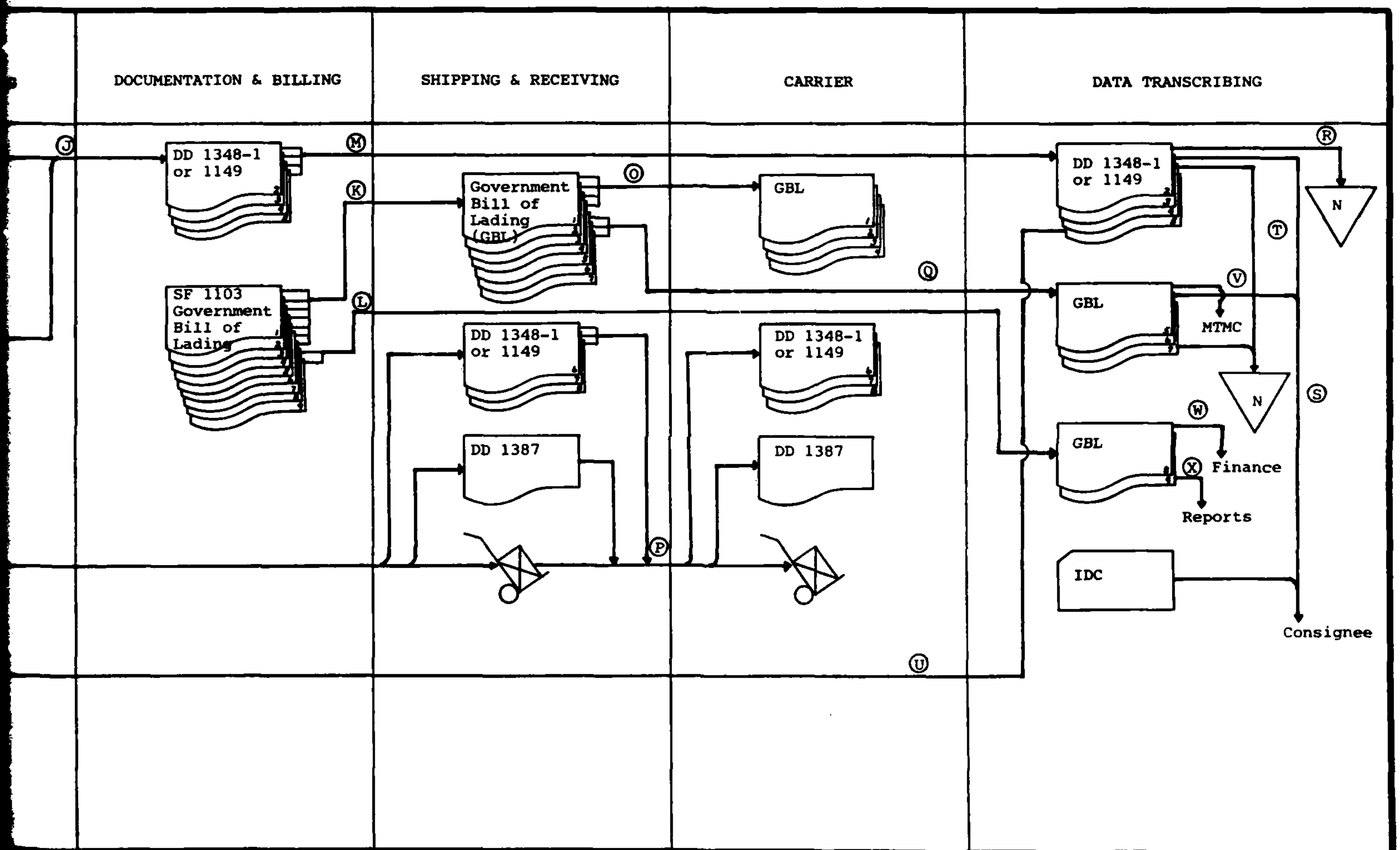


Fig 11. Wright-Patterson AFB Document Flowchart



DOCUMENTATION & BILLING
SHIPPING & RECEIVING
CARRIER
DATA TRANSCRIBING
J
M
K
L
O
P
Q
R
S
T
U
V
W
X
DD 1348-1 or 1149
SF 1103 Government Bill of Lading
Government Bill of Lading (GBL)
DD 1348-1 or 1149
DD 1387
GBL
DD 1348-1 or 1149
DD 1387
DD 1348-1 or 1149
GBL
GBL
IDC
N
N
MTMC
Finance
Reports
Consignee

Just as there were exceptions to the physical flow chart in Figure 10, so too are there many exceptions to the document flowchart for a mission GBL shipment just described. For example, shipments moving on a DD Form 1385, Cargo Manifest (e.g., consignee pickup, Parcel Post, LOGAIR), involve four copies of the manifest, three of which are sent to Shipping and Receiving while one is held in suspense in Data Transcribing. Two of the three copies sent to Shipping and Receiving go with the materiel, and the third copy is signed by the carrier and returned to Data Transcribing, at which time the suspense copy is discarded. Shipments moving on UPS manifests involve one less copy than the cargo manifest shipments with similar distribution. Commercial Bills of Lading, used for shipments moving on a cash on delivery (C.O.D.) basis, also are prepared in three copies and are distributed similar to UPS manifests.

Two other classes of cargo, hazardous and classified/sensitive shipments, involve preparation of additional specialized paperwork. Hazardous shipments require the preparation by Packaging and Preservation or Shipment Planning of a DD Form 1387-2, Special Handling Data/Certification in five copies. Two of the five copies go with the materiel, while the remaining three copies are forwarded to Documentation and Billing. Of the three forwarded copies, one is attached to the suspense copy of the shipping document for file, and two copies are attached to the shipment paperwork given to the carrier. For classified/sensitive shipments, an AF Form 127, Traffic Transfer Receipt is prepared and used as an internal receipt as the materiel passes through various sections of the Surface Freight Unit. Signed copies of 127's are filed in each section with any copies remaining after carrier pickup being filed with the GBL/manifest in the property shipped file. Should a classified/sensitive shipment move commercially, the 127 is converted to the commercially equivalent Standard Form 1907. All copies of the SF 1907 are then sent to Shipping and Receiving with one copy signed by the carrier and returned to Data Transcribing.

A final documentation exception worth noting involves STS shipments which require preparation of an advance load departure message. This message is sent to destinations (Tinker AFB, Kelly AFB or Robins AFB) to advise of shipments enroute.

Besides physical and document flowcharts, a third tool often used to illustrate an existing system is the systems flowchart. This type of flowchart depicts the hardware configuration of a system. Because the only system component that could even loosely be construed as "hardware" is the keypunch machine used to prepare IDC's and cards for workload reports, we determined the preparation of a systems flowchart was not necessary.

Following our study of the WPAFB Surface Freight Unit, similar research was conducted at NAFS, the results of which are detailed next.

Newark AFS Models

Newark AFS, located in Heath, Ohio, works closely with Wright-Patterson AFB since an estimated 85 per cent of their outbound cargo is forwarded to WPAFB for transshipment through the LOGAIR system. In support of the station's mission to repair missile inertial guidance systems and aircraft guidance systems for all services, the freight section processes approximately 2500 documents per month for the outbound shipment of these high value items. The organization of the surface freight unit, shown in Figure 12, denotes the scaled-down operation of the entire transportation branch relative to Wright-Patterson.

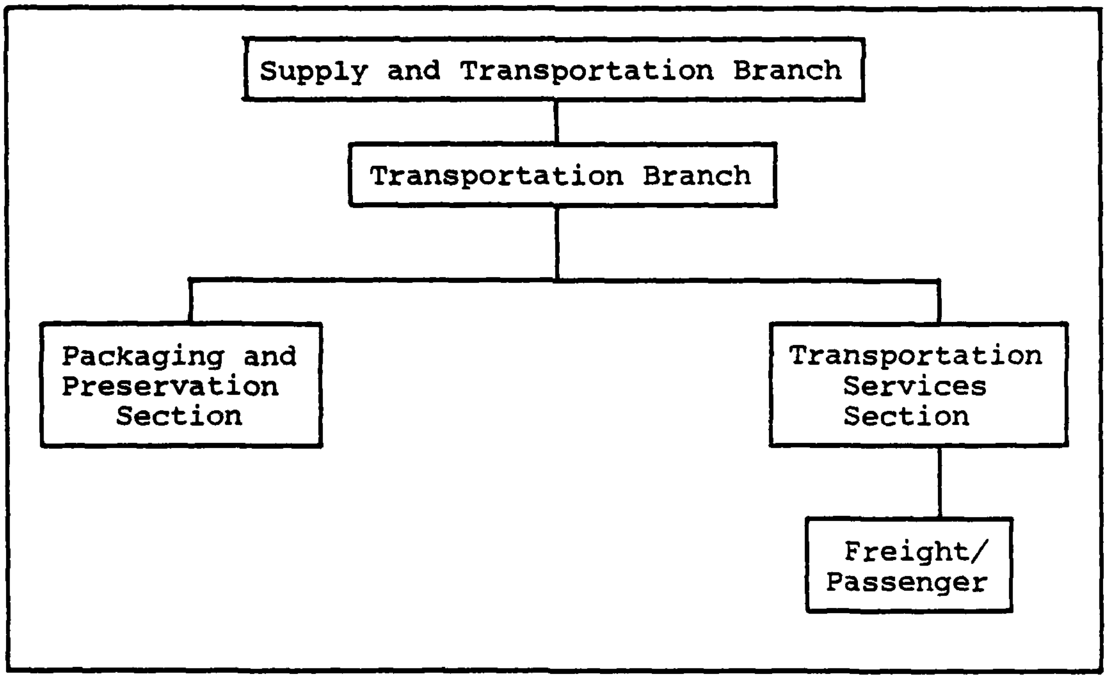


Fig 12. Organization of Newark AFS Transportation Branch

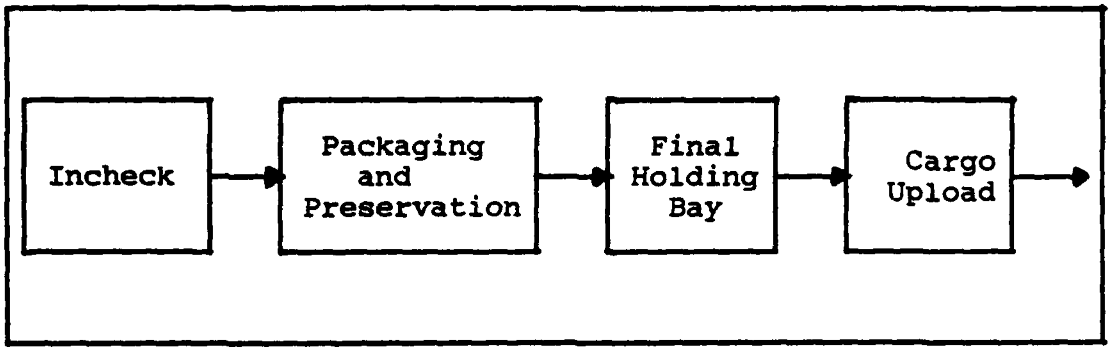


Fig 13. Newark AFS Physical Flowchart

Due to the more controlled flow of outbound materiel into the surface freight section for shipment and insufficient warehouse space, the physical flow of materiel at NAFS is also more condensed in comparison to WPAFB (see Figure 13). The Packaging and Preservation Section both inchecks and packages materiel before staging in a final holding bay awaiting carrier pickup. Temporary storage or rewarehousing of outbound materiel into various storage bays does not occur unless the proper shipping package is not immediately available.

The document flowchart for Newark AFS, shown in Figure 14 (see page 57), illustrates the most common paperwork flow experienced: a shipment of materiel destined for WPAFB via military vehicle for transshipment into the LOGAIR system. In this instance, the cargo manifest, rather than the GBL is prepared by the Documentation and Billing function. However, it should be noted here that both forms are applicable for use at either location depending on the type of shipment. Other differences between the two documentation flowcharts include the:

o receipt of materiel and documents from the shipper by Packaging and Preservation (A & B)

o preparation of the shipment label by the Administration Section after receipt of shipping documents from Shipment Planning (E)

o forwarding of the shipment label and accompanying documents directly from the Administration Section to Packaging and Preservation (F)

o return of appropriate copies of the shipping documents to Shipment Planning from Packaging and Preservation after the actual pieces, weight and cube of the package containing the materiel is annotated on them (H)

o preparation of only three copies of the cargo manifest by Documentation and Billing with two copies being forwarded to Shipping and Receiving (K)

o receipt of one copy of the manifest from Shipping and Receiving to the carrier (M)

o suspense of the third copy of the manifest in Documentation and Billing awaiting the return of the carrier receipted copy of the manifest from Shipping and Receiving (N)

o distribution of documents by the Administration Section after the materiel shipment (P through T).

Finally, since the hardware configuration at NAFS is similar to WPAFB, the preparation of a systems flowchart is unnecessary.

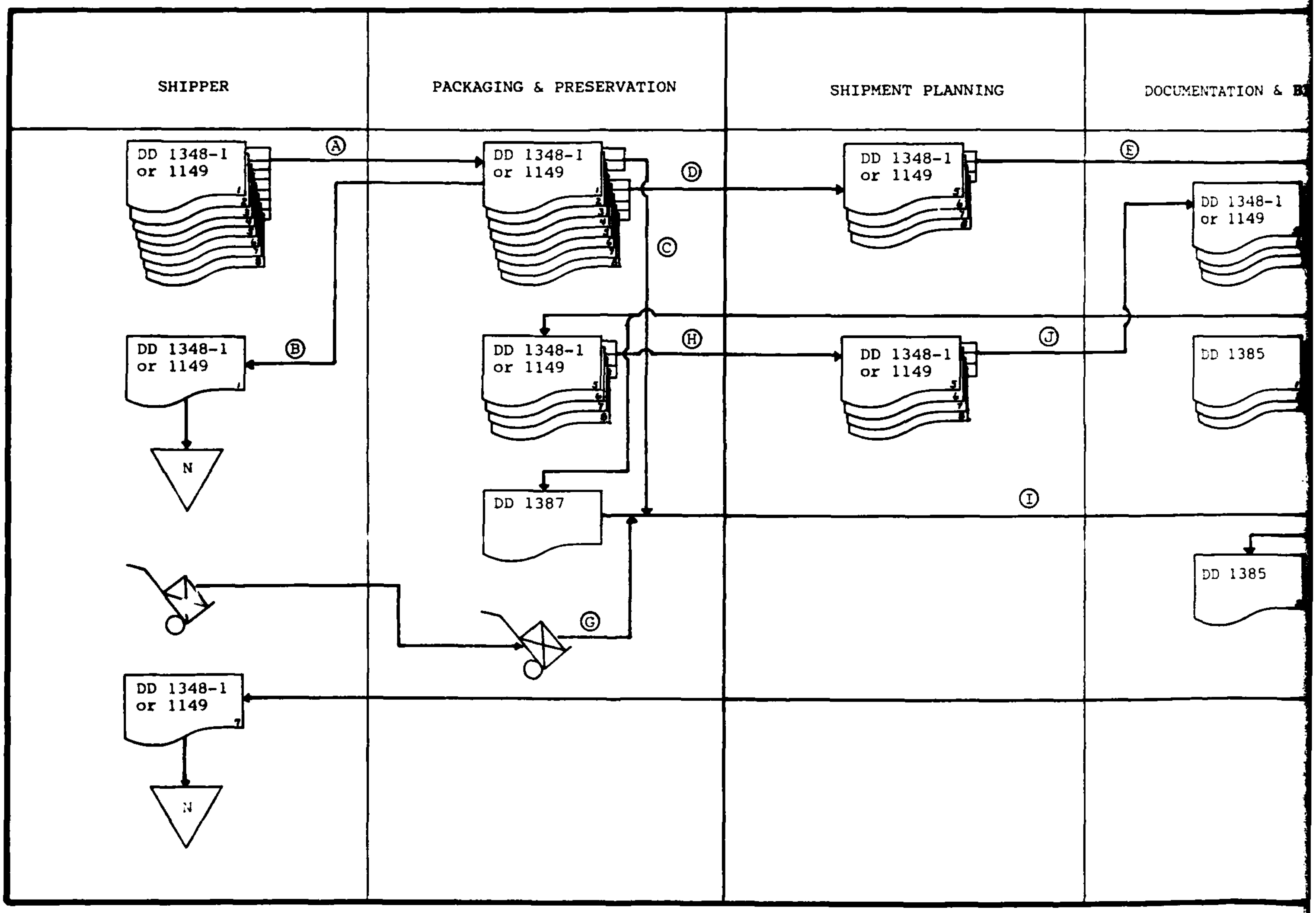
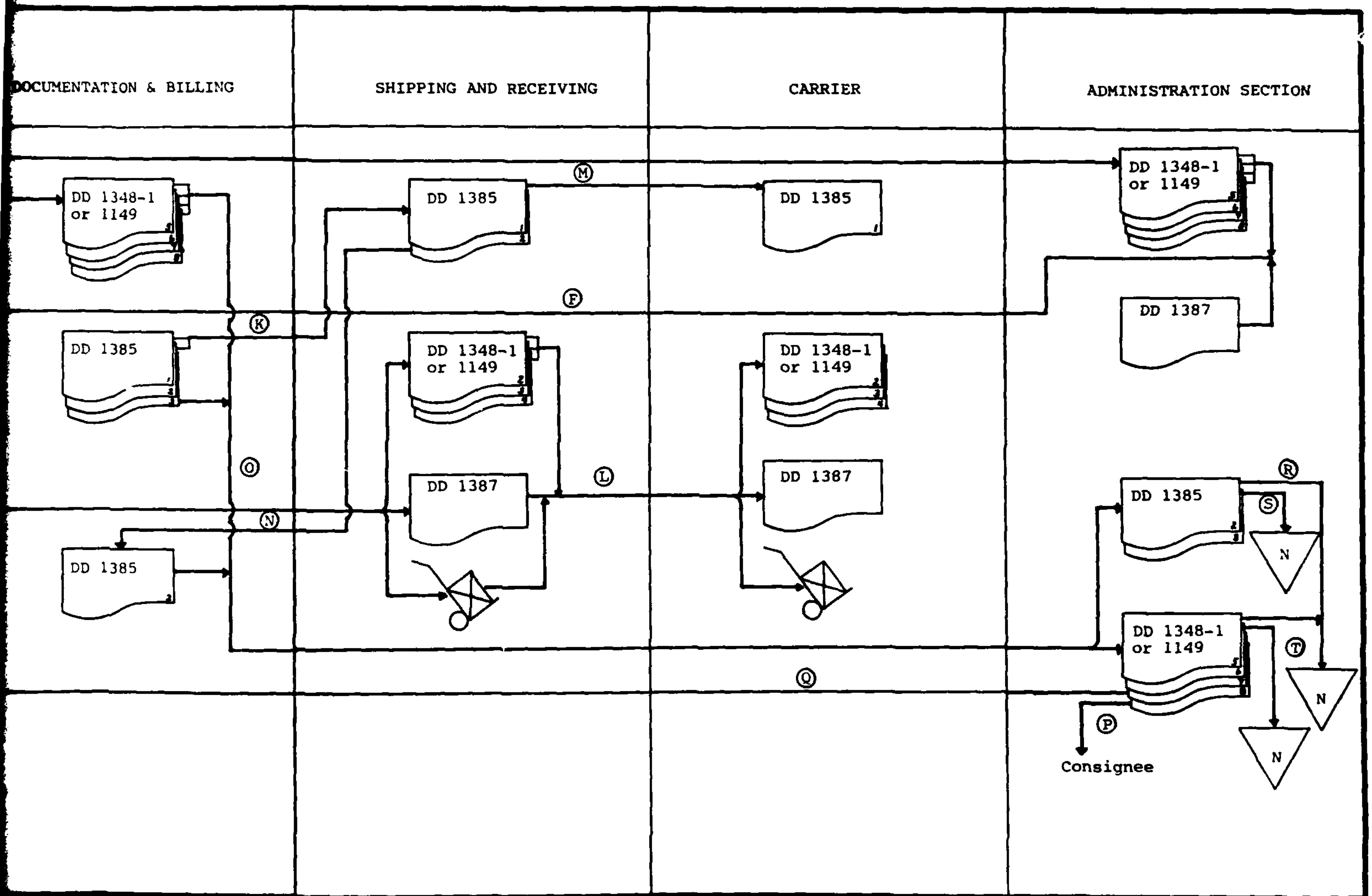


Fig 14. Newark AFS Document Flowchart



t Flowchart

2

Major Problems

As a result of our research at WPAFB and NAFS, several major problems or potential problems with the existing system for processing outbound surface freight shipments were identified. The problems can be grouped into four general categories: documentation, customer service, reports generation and inventory control.

The first of these four categories, documentation, includes problems relating to document preparation, flow, status, regulatory requirements and filing. The specific problems are:

- Current methods of document preparation are labor intensive, time-consuming and highly prone to error.
- Existing document flow procedures are slow and exhibit a high potential for loss and/or mishandling of critical shipment paperwork.
- The status of a shipment and its accompanying documentation as it progresses through the surface freight unit is difficult to ascertain.
- The profusion of codes, statements, instructions, etc. which must be extracted from numerous regulations slows the document preparation process and often results in inaccurate paperwork.
- The present system for filing shipment paperwork utilizes excessive space, does not facilitate timely access to and retrieval of documents and is void of safeguards which prevent lost or misfiled documents.

Customer service, the second of the four problem categories, involves tracing shipments in order to handle customer queries. The shortcomings identified with respect to customer service are:

- Current manual tracing procedures do not afford timely recovery of shipment information for responding to customer inquiries.

- Traceability is severely hampered by the requirement placed on the shipper to provide a specific piece of shipment information, such as TCN or date shipped.

The third of the general problem areas, reports generation, includes recording, compiling and submitting workload data from among several surface freight sections. Problems noted in this category are:

- The time spent manually maintaining workload data logs in several surface freight sections could be better utilized in direct mission support.

- Fragmentation of workload data collection among several sections does not lend itself to integration of the data for compiling reports.

- The manual recording, compiling and submission of workload data inherently results in less than accurate reports, which can serve as the basis for loss of manpower authorizations.

Inventory control, the final problem category, includes issues concerning the control of packaging materials and of shipments in the surface freight system. Deficiencies noted are:

- Existing provisions for replenishment of packaging materials do not allow for timely follow-up on requisitions and backorders, resulting in unnecessary shipment delays and a reduced level of customer service.

- The present system does not allow positive control over number and location of shipments within surface freight.

The 12 specific problems outlined above indicate substantial room for improvement in a wide range of current outbound surface freight processes. The next chapter describes our proposed improved system and includes our recommendations which address these problems.

V. Functional Model of the Proposed System

Overview

Our study of the present outbound surface freight operations at Wright-Patterson Air Force Base and Newark Air Force Station revealed several problem areas or potential problem areas relative to information accessibility and flow. Based on these problems, a new system was designed using structured systems analysis techniques to show areas where automation of information could provide benefits to the present operations in terms of efficiency and accuracy. Although there are peculiarities in the documentation flow at each location, the basic processes and uses of information are the same. For this reason, designing only one proposed system was necessary. Following a description of the functional model of the proposed system, we will discuss our specific recommendations.

Data Flow Diagram

In our research, Structured Systems Analysis, specifically a data flow diagram (DFD), was used to build a logical model of the proposed outbound surface freight system (see Figure 15, page 67).[4] The alphabetical codes (external entities), numeric codes (processes) and alphanumeric codes (data stores) in the following narrative correspond to those in Figure 15.

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[4] Refer to Figure 7, page 37, for an explanation of the symbols used in a DFD.

The documentation flow in outbound surface freight begins when the shipping documents accompanying the materiel are brought into the system by either an on-base shipper (S), for originating or mission shipments, or a carrier (C) for transshipments. Each document is reviewed (1) to ensure that all important information concerning the materiel and the consignee is present or available in the data store. Recommended elements of information (also called data "attributes") that should be included in these data stores are: stock number, nomenclature and hazardous designation (if applicable) in the Materiel data store (D1) and name, complete address and DOD Activity Address Code (DODAAC) in the Consignee store (D2). Two processes occur following document editing: a copy of the shipping document is signed and returned to the shipper/carrier, acknowledging receipt of the item (2), and the Shipment History is created (3). The Shipment History data store (D3) serves as an ongoing record of cargo movement through Outbound Surface Freight as well as the primary source of information for responding to customer queries. It is updated as the documentation moves through the system and will ultimately include: date received, transportation control number, shipment priority, pieces, weight, cube, special handling and shipment type codes, carrier, mode, consignee, GBL/manifest number and date shipped.

After the receipt copy of the shipping document is returned to the shipper/carrier (2), the remaining copies of the shipping document are divided so that shipment movement can be planned and the materiel can be packed. Routing and rating the shipment (4) start the shipment planning activities and involve drawing information from three data stores. In addition to the name, complete address and DODAAC mentioned above, attributes describing special movement considerations (e.g., who to contact, delivery times, etc.) are needed in the Consignee data store (D2). The Materiel data store (D1) should include attributes indicating specialized transport requirements, while the Carrier data store (D4) should contain specific carrier facts such as name, address, services offered and freight rate information. Once the carrier has been selected, the Tonnage Distribution Roster (TDR), a record insuring fair distribution of tonnage among eligible carriers, is updated (5). The TDR data store (D5) requires such attributes as carrier name, date and tonnage of individual shipments tendered and cumulative tonnage for the period. As this TDR updating process occurs, a shipment label is generated (6) from consignee data. Finally, completing shipment planning activities, the shipping document is updated with routing information (7), and routing details are entered (8) into the Shipment History (D3).

As shipment planning activities are being accomplished, the materiel is being packaged and prepared for movement. The copies of the shipping document accompanying the materiel are used as the basis for determining required packaging (9).

Two data stores, Materiel (D1) and Packaging Publications (D6), provide packaging information. In addition to attributes previously mentioned, the Materiel data store should include type pack required and any specialized packaging instructions. The Packaging Publications data store should contain general packaging information concerning labeling, taping, marking, etc. The determination of required packaging process will reveal whether or not packaging is needed. When packaging is required, a determination as to the availability of specific packaging materials is made (10). This is done by checking the Packaging Inventory data store (D7), containing such packaging material attributes as stock number, nomenclature and quantity on hand. Should needed packaging materials be unavailable, a backorder (for out-of-stock items) or a requisition (for non-inventory items) is generated (11). Both the Backorders (D8) and Requisitions (D9) data stores will specify the order attributes of item source, nomenclature, stock number, quantity ordered, date ordered, follow-up date and date received. These two data stores could also be used to handle queries (12) concerning shipment status from either shippers (S) or management (M). When the backorder or requisition is filled, the applicable requisition/backorder and inventory data stores are updated (13). When it is determined, however, that the required packaging is available in stock (refer to process 10), the inventory must be adjusted (14) and reflected in the Inventory data store (D7). When required packaging is determined (9) and it is established that the materiel was delivered in the proper package, no additional packaging items are needed from inventory. In this case, the materiel is prepared for shipment (e.g., taped, marked and labeled, etc.) and the actual pieces, weight and cube of the shipment are determined (15). This same process is completed for all other shipments mentioned above after the required package is obtained and the materiel is properly packaged for shipment. The packaging data, the actual pieces, weight and cube of the shipment, are used in three processes: the first use is for the completion of the shipping label (6); the second use is updating the shipping document (7); and the third use is for entering the packaging details (16) into the Shipment History (D3).

The copies of the shipping document that have been updated with routing and packaging information are then sorted by the type of billing and documentation required (17), e.g., UPS manifests, GBL's, Parcel Post manifests, etc., and, based on the type of shipment, the appropriate documentation is generated (18). The several required statements and codes needed to complete the documentation are available in the Shipping Regulation data store (D10). Following completion of the documentation, the billing data is entered (19) into the Shipment History (D3) and part of the shipment documentation is placed in a shipment suspense file (20). The remaining shipment documentation is updated with the warehouse location of its appropriate materiel (21) and given to the carrier (C). The carrier (C) then signs for the shipment and returns the receipted copies of the documents to Outbound Surface Freight. The carrier-receipted documents are matched to the shipment documentation in the suspense file for final processing and distribution. After the final shipment data is entered (22) into the Shipment History (D3), the copies of the shipment documentation in the suspense file (20) are updated (23). The shipment documentation is sorted (24), with applicable copies being forwarded to the shipper (S), the consignee (E) and MTMC (T). The remaining copies are placed in a Shipment Record data store (D11) for handling special queries (26) from management (M). As mentioned earlier, the shipment details available in the Shipment History data store (D3) are useful in handling customer queries (27) from either shippers (S) or consignees (E). This data store (D3) can also provide the workload details necessary for the preparation of workload reports and handling of queries (25) for Management (M) and, ultimately, Headquarters (H).

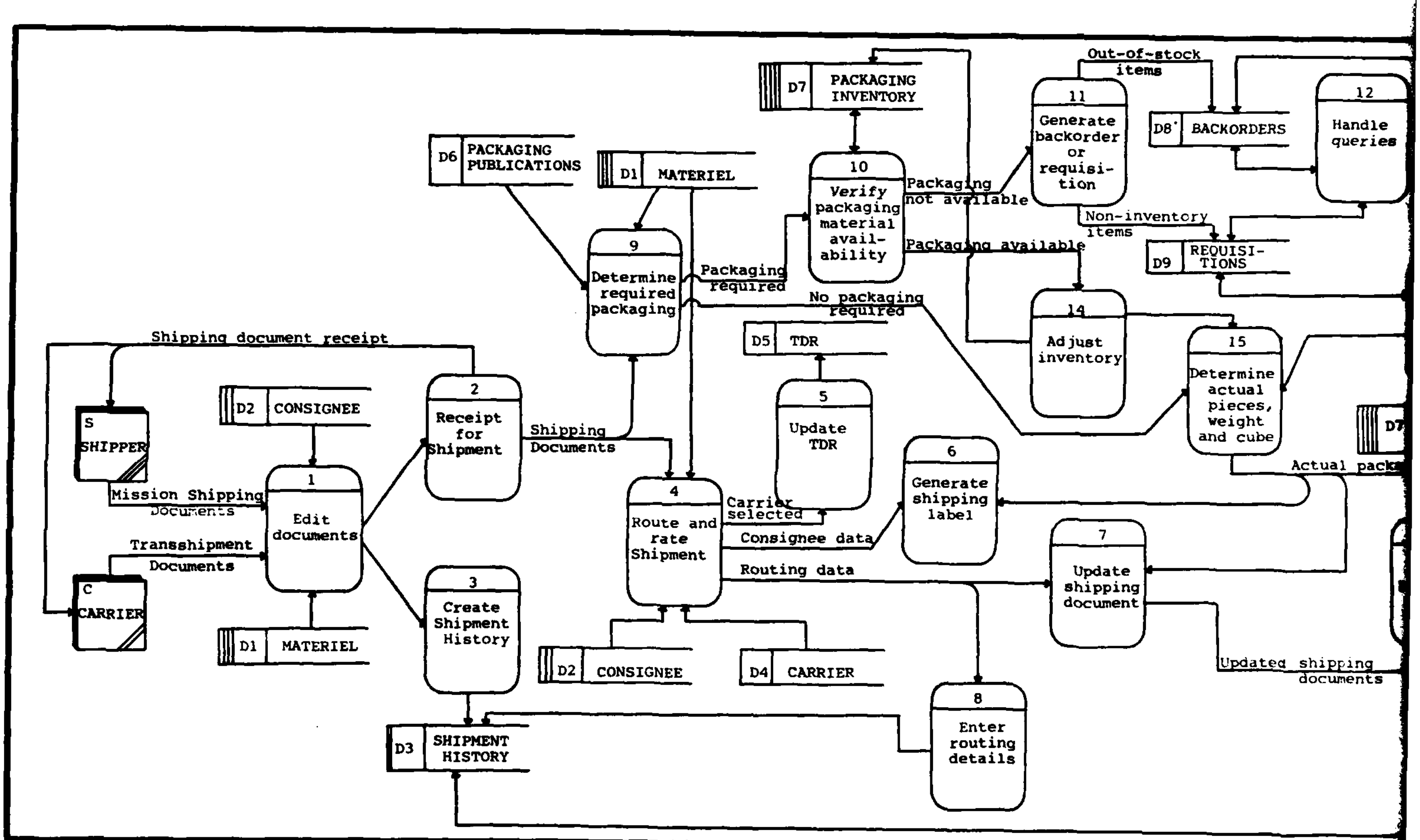
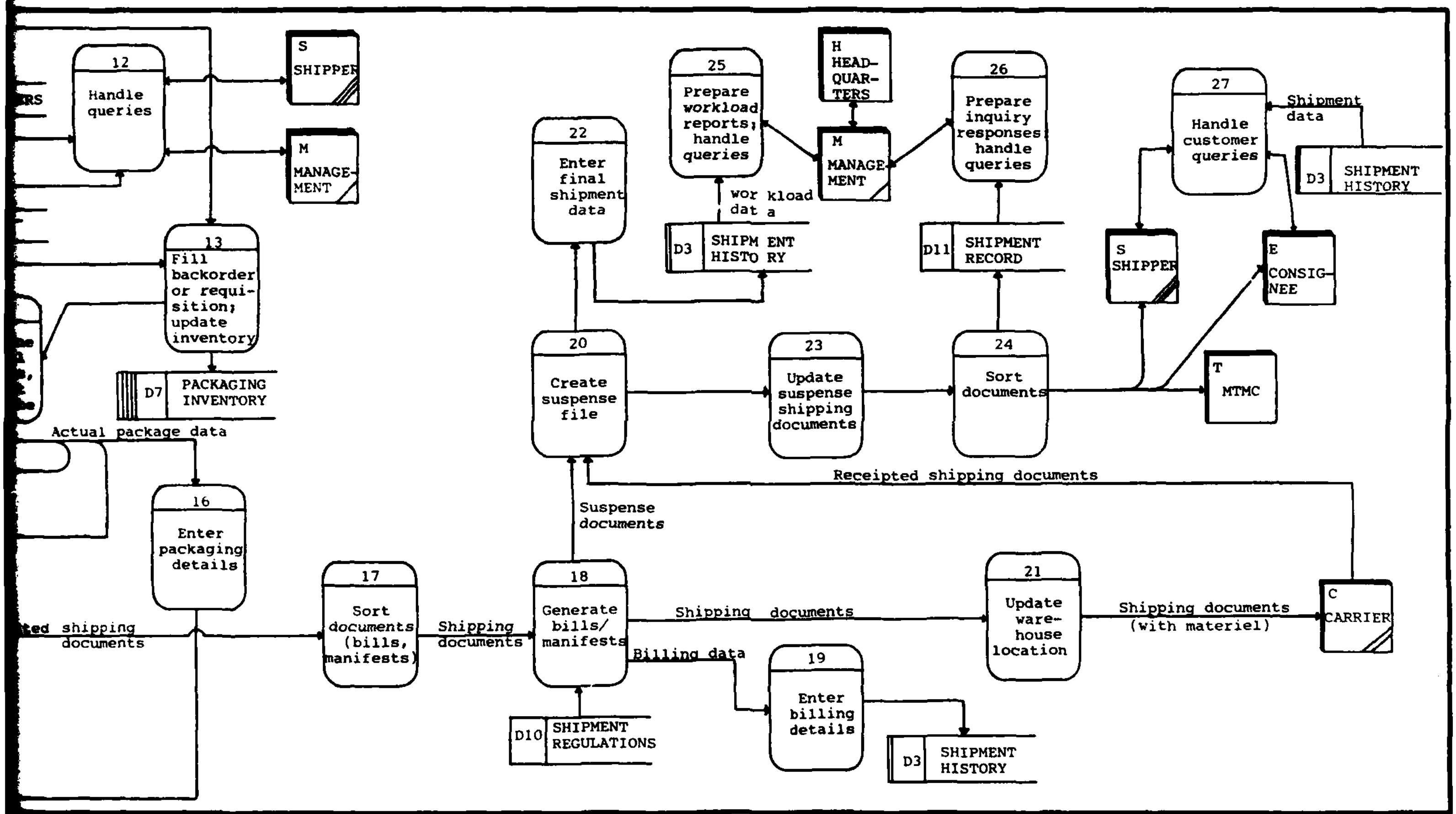


Fig 15. Data Flow Diagram of the Proposed System



12 Handle queries
S SHIPPER
M MANAGEMENT
13 Fill backorder or requisition; update inventory
D7 PACKAGING INVENTORY
Actual package data
16 Enter packaging details
shipping documents
17 Sort documents (bills, manifests)
Shipping documents
18 Generate bills/ manifests
D10 SHIPMENT REGULATIONS
Suspense documents
20 Create suspense file
22 Enter final shipment data
25 Prepare workload reports; handle queries
workload data
D3 SHIPMENT HISTORY
H HEADQUARTERS
M MANAGEMENT
26 Prepare inquiry responses; handle queries
D11 SHIPMENT RECORD
23 Update suspense shipping documents
24 Sort documents
S SHIPPER
T MTMC
E CONSIGNEE
27 Handle customer queries
Shipment data
D3 SHIPMENT HISTORY
Receipted shipping documents
Shipping documents
Billing data
19 Enter billing details
D3 SHIPMENT HISTORY
21 Update warehouse location
Shipping documents (with materiel)
C CARRIER

2

Recommendations

The proposed system described in the previous section incorporates several improvements designed to alleviate the major problems we found in our study of the existing system. The DFD, or, more specifically, the 11 data stores created in the DFD, identifies the information needed to manage outbound surface freight using the On-Line Cargo Movement System. Our recommendations address the potential benefits of an automated system such as the OLCMS over the existing predominantly manual operation. Since a single recommendation may address several of the problems reported in Chapter 4, the following list is organized in order of relative importance rather than by the major problem categories of documentation, customer service, reports generation and inventory control.

Recommendation 1. Consolidate workload and shipment data into one file, called Shipment History, containing those attributes described in the DFD's Shipment History data store. With automation, this file could be updated with current information as the documentation progressed through outbound surface freight functions. The Shipment History would allow surface freight personnel to accurately determine the status of a particular shipment and its accompanying documentation and would also provide positive control over the total number of shipments in the system. This up-to-date shipment status information could in turn be used to improve customer service by affording timely recovery of the data needed for responding to customer inquiries. Also, because of the wide variety of shipment attributes that we proposed to be included in the Shipment History, a customer would no longer be constrained to the one or two critical data elements presently required for tracing a shipment. Finally, shipment history information would facilitate all aspects of reports generation as outlined in greater detail in Recommendation 3 below.

Recommendation 2. Consideration should be given to acquiring automated word processing equipment. Such equipment, by improving document preparation both in terms of speed and accuracy, could allow management to redirect a portion of the administrative workforce to direct mission support duties. Beyond the preparation of shipment documentation, automated word processing equipment has applications for improving reports generation and inventory control as discussed in later recommendations.

Recommendation 3. Centralize the recording, compiling and submission of workload data. Automating the many presently manually maintained workload data logs, such as the TDR, would significantly reduce the time required to record workload data. By incorporating running totals into the workload data contained in the Shipment History, data required for periodic reports can be easily obtained. Also, word processing equipment and electronic data transmission would aid reports preparation and submission. These improvements in recording, compiling and submission of workload data would result in much more efficient reports generation.

Recommendation 4. Replace the present manual filing procedures with an automated filing system. Such a system, while reducing the amount of space required, would facilitate timely access to and retrieval of documents and prevent loss and/or misfiling of documents.

Recommendation 5. Incorporate electronic document transmission capability in the proposed automated system. Present procedures involve mailing advance shipment documents to consignees. Electronic transmission would be faster and would also reduce the frequent loss/mishandling of documents which now occurs.

Recommendation 6. Consolidate codes, statements and instructions required in the preparation of documents into a series of user/task-oriented files. Currently, this multitude of information must be manually researched and extracted from numerous local, command, service and joint publications. Locating and organizing this information in some more useable fashion, such as the Carrier, Consignee, Materiel and Shipment Regulations data stores in the DFD, would reduce the time required for and improve the accuracy of document preparation.

Recommendation 7. Establish an automated packaging material inventory control system. This system would replace existing manual procedures, under which backorder/

requisition status is often not tracked, and inventory consumption records are less than accurate. Automatic monitoring of backorders, requisitions and inventory-on-hand would help prevent unnecessary shipment delays due to unavailability of packaging materials, thereby improving customer service.

Inclusion of the above seven recommendations in the OLCMS should resolve the 12 major problems we identified in the present outbound surface freight system. It should be noted that the degree of automation needed at individual installations will vary depending on the volume of cargo moved. For example, the degree of automation needed at a high-volume activity like Wright-Patterson is much greater than that needed at a lower volume activity like Newark. Ideally, some evaluation of costs versus benefits must be made in determining this proper degree of automation.

Chapter 6 first summarizes our research and recommendations, then presents recommendations for further research and conclusions.

VI. Summary, Recommendations and Conclusions

Summary

The overall purpose of this thesis research was to assist the Air Force Data Systems Design Center in the development of an automated management information system for cargo movement by identifying the information needs of the OLCMS when processing cargo in outbound surface freight. To achieve this purpose, the following four research subobjectives were identified:

- Define the current outbound surface freight system.
- Identify the required decisions/tasks of the system.
- Determine the information needs for the required decisions/tasks.
- Outline the general system objectives needed to support known information requirements.

To achieve these research subobjectives, several techniques and tools were employed in our three-step methodology for systems analysis. In the first step, determining the theoretical operation of an outbound surface freight system, interviews and documentation review were used. The second step, defining the existing outbound surface freight system, involved observation, documentation review, flowcharting and interviews. Recommending a new or improved system, the final step, made use of interviews and structured systems analysis.

Analysis of the existing outbound surface freight system revealed 12 major problems. Using structured systems analysis, a functional model of a proposed system was developed which addressed the major problems identified. Further analysis resulted in the recommendations summarized below.

Recommendations

Research Recommendations. The seven recommendations listed below resulted from our research in developing a proposed outbound surface freight system.

Recommendation 1. Consolidate workload and shipment data into one file called Shipment History.

Recommendation 2. Consideration should be given to acquiring automated word processing equipment.

Recommendation 3. Centralize the recording, compiling and submission of workload data.

Recommendation 4. Replace the present manual filing procedures with an automated filing system.

Recommendation 5. Incorporate electronic document transmission capability in the proposed automated system.

Recommendation 6. Consolidate codes, statements and instructions required in the preparation of documents into a series of user/task-oriented files.

Recommendation 7. Establish an automated packaging material inventory control system.

Recommendations for Further Research. During the course of our study effort, several areas for further research were identified. Four such opportunities are summarized in the recommendations below.

Recommendation 1. Apply our methodology for systems analysis to outbound surface freight activities at other military installations. Such research would aid in the validation of our findings and recommendations.

Recommendation 2. Apply our systems analysis methodology to other components of the base-level cargo movement system, such as inbound surface freight and inbound/outbound air freight. Research of this nature would further assist the AFDSDC in the development of the OLCMS.

Recommendation 3. Complete the remaining system development activities - general systems design, systems evaluation and justification, detail systems design, systems implementation - necessary to bring the OLCMS into being.

Recommendation 4. Conduct detailed cost/benefit analyses to determine the degree of automation warranted at individual installations based on volume of cargo moved. This determination needs to be made to guard against inefficient use of resources.

Conclusions

The major conclusion from our research is that an automated system such as the OLCMS would provide potentially far-reaching benefits to outbound surface freight specifically and, more generally, to the other components of the base-level cargo movement system as well. As our research recommendations indicated, we believe that an automated system, integrating data processing and word processing technologies, can be developed which will overcome the many shortcomings of the existing manual system for cargo movement. Therefore, the current effort to develop the On-Line Cargo Movement System should be continued. This research has assisted the Air Force Data Systems Design Center in that development effort.

Appendix: Interview Guides

INTERVIEW GUIDE #1 - FACT FINDING

Introduction:

1. Research team introductions
2. Thesis overview
   - o topic selected - background
   - o objective
3. Purpose
   - o to gather background information on surface freight and advice on particular documentation to review
4. Team functions in interview
5. Tape recorder

Interview Topics:

1. Cargo documentation flow through outbound surface freight
   - o generalizability of procedures across bases, commands, CONUS/overseas
2. Recommended documentation to review:
   - o regulations/manuals
   - o reports
3. Number of outbound surface freight functions to observe and recommended bases to visit
4. Interviewee's feelings on general usefulness of the research
5. Other experts recommended for interviews

Closing:

1. Summarize main points
2. Identify points requiring further discussion
3. Arrange follow-up interview, if necessary
4. Thank the interviewee

INTERVIEW GUIDE #2 - FACT FINDING

Introduction:

1. Research team introductions
2. Thesis overview
   - o topic selected - background
   - o objective
3. Purpose
   - o to gather information on the present cargo/data flow in outbound surface freight
   - o to review documentation used in the cargo/data flow process
   - o team functions in interview
   - o tape recorder

Interview Questions:

1. What is your job title?
   - o What are your basic responsibilities?
2. When processing cargo for normal outbound shipment -
   - o what are the documents you receive?
   - o who do you receive shipping documents from?
   - o how do you use these documents in performing your job?
   - o what steps do you take to do your job (tasks performed)?
   - o do you need to work with/talk to others to do your job?
     - o who are they, what organization do they belong to?
     - o what information do they provide?
     - o what information do you provide them?
   - o what paperwork do you create (forms, documents, reports)?
   - o do you need to refer to any regulations, documents, reports, catelogs to gather information?
     - o what information do you need from them?
   - o what forms do you maintain (retain in files) and for what purpose?
   - o what forms do you forward to others?
     - o who are they forwarded to?
     - o how many copies?
     - o what method do you use to forward them?
3. What paperwork is required for special cargo?
   - o what different categories of cargo require special handling?
   - o what information does the completion of the paperwork require?

INTERVIEW GUIDE #2 - FACT FINDING/cont.

   - where do the forms go (distribution) when completed?
   - who do you need to talk to?
4. Are there any other times or are there any other special cases when you are required to perpare any paperwork related to an outbound shipment?
   - what are the circumstances?
   - what forms are required?
   - what information do you need?
   - where do the forms go (distribution) when completed?
   - who do you need to talk to?
5. Do you handle cargo as part of your job?
   - in what way - how does the cargo move through your area?
   - what do you do with the cargo?
6. Do you use any machines in processing paperwork?
   - what does the machine do?

Closing:

1. Summarize main points
2. Identify points requiring further discussion
3. Arrange follow-up interview, if necessary
4. Thank the interviewee

INTERVIEW GUIDE #3 -
PROBLEM IDENTIFICATION/SOLUTION DISCUSSION

Introduction:

1. Reintroduction of research team
2. Thesis overview
   - o topic selected and objective
   - o progress made to date
3. Purpose
   - o to identify potential problems in the data flow in outbound surface freight
   - o to gather possible methods for improving the data flow
4. Team functions in interview
5. Tape recorder

Interview Questions:

1. What documents do you use most often in your job?
   - o what information do you get from each document?
2. Do you use information which takes you a long time to find - does it seem like there ought to be a better way?
3. Does the paperwork you must prepare present you any problems?
4. Have you ever worked with computers? If so:
   - o in what capacity?
   - o did you experience any problems?
   - o what recommendations might you have for improving their usefulness to you?
5. Have you ever worked with CRT's? (define CRT as a keyboard with screen) If so:
   - o in what capacity?
   - o did you experience any problems?
   - o what recommendations might you have for improving their usefulness to you?
6. Have you ever worked with computer output? (listings, printouts, etc.) If so:
   - o in what capacity?
   - o did you experience any problems?
   - o what recommendations might you have for improving their usefulness to you?
7. Does anyone ever contact you requesting information on outbound shipments? If so:
   - o who?
   - o what things do they want to know?
   - o where do you get the information to answer?
   - o where (in what source) do you go first?
   - o what do you look up first?

INTERVIEW GUIDE #3 -
PROBLEM IDENTIFICATION/SOLUTION DISCUSSION/cont.

8. If you could use a CRT, what information would you think you would like to have available and why?
9. If information was available in the computer, what benefits would you expect from it in doing your job?

Closing:

1. Summarize main points
2. Identify points requiring further discussion
3. Arrange follow-up interview, if necessary
4. Thank the interviewee

INTERVIEW GUIDE #4 - AUTHOR/REVIEWER INTERVIEW TALK SESSION

Introduction:

1. Research team greetings
2. Thesis overview
   - o topic and objective
   - o review of research completed
3. Purpose
   - o to ensure accuracy of documentation flow models
   - o to gain further data to enhance research recommendations and conclusions

Interview Topics:

1. Explanation of documentation flow models for outbound surface freight
   - o generalizability to a common documentation flow
   - o accuracy
2. Review of exceptions to model
   - o type, impact, differences
3. Recommended changes to model
4. Review of proposed improvements to the existing system

Closing:

1. Summarize main points
2. Arrange follow-up interview, if necessary
3. Thank the interviewee

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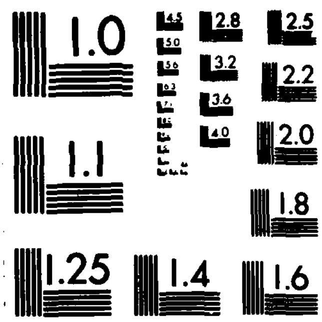

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This research assisted the Air Force Data Systems Design Center in the development of an automated management information system for cargo movement by identifying the information needs of the On-Line Cargo Movement System when processing cargo in outbound surface freight. To accomplish this research, the following four subobjectives were identified:

- o Define the current outbound surface freight system.
- o Identify the required decisions/tasks of the system.
- o Determine the information needs for the required decisions/tasks.
- o Outline the general system objectives needed to support known information requirements.

To achieve these research subobjectives, several systems analysis techniques and tools were employed in a three-step methodology. In the first step, determining the theoretical operation of an outbound surface freight system, interviews and documentation review were used. The second step, defining the existing outbound surface freight system, involved observation, documentation review, flowcharting and interviews. Recommending a new or improved system, the final step, made use of interviews and structured systems analysis.

Analysis of the existing outbound surface freight system revealed 12 major problems in the four general areas of documentation, customer service, reports generation and inventory control. Further analysis resulted in the following recommendations:

- o Consolidate workload and shipment data into one file called Shipment History.
- o Consideration should be given to acquiring automated word processing equipment.
- o Centralize the recording, compiling and submission of workload data.
- o Replace the present manual filing procedures with an automated filing system.
- o Incorporate electronic document transmission capability in the proposed automated system.
- o Consolidate codes, statements and instructions required in the preparation of documents into a series of user/task-oriented files.
- o Establish an automated packaging material inventory control system.

The major conclusion of this research was that an automated system incorporating the recommended capabilities could be developed. Therefore, current efforts to develop the On-Line Cargo Movement System should continue.